ON

SOME OF THE MORE OBSCURE FORMS

OF

NERVOUS AFFECTIONS:

Their Pathology and Treatment,

WITH AN INTRODUCTION,

ON

THE PHYSIOLOGY OF DIGESTION AND ASSIMILATION, AND THE GENERATION, AND DISTRIBUTION, OF NERVE FORCE,

Based upon Original Microscopical Observations.

BY

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ILLUSTRATED WITH ORIGINAL ENGRAVINGS,

DRAWN ON WOOD BY THE AUTHOR.

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PREFACE.

"THE eye sees what it brings the power to see," says Carlyle, and this aphorism will serve as a prefatory remark to my Microscopical Observations, leaving to time to prove or disprove their correctness.

The engravings were drawn on wood by myself, and give a very tolerable idea of what I wish to convey.

I am perfectly aware of the incompleteness of my views upon the generation and distribution of nerve force, but I offer them as the first fruits of my labours, hoping eventually, and by degrees, to collect a sufficient number of facts to enable me to perfect a theory upon this abstruse subject.

In the Second Part I have endeavoured to explain how very different diseases may give rise to very similar trains of nervous symptoms; how, by the microscopical and chemical examination of the urine, we are best enabled to discriminate between them; as well as how, by ascertaining the exciting cause of any affection, it may be removed by appropriate treatment directed to *it*, rather than to the resulting effects.

The Therapeutics of Galvanic Electricity are but

in their extreme infancy; but I have seen such wonderful effects produced upon disease by its influence, that I am convinced that great rewards are open to those, who will conscientiously study the laws governing this subtle force.

To MR. POLLOCK I am indebted for the explanation of molecular vibration, and the forms taken by the ultimate atoms of matter.

To conclude, I cannot make use of a better formula than that of the MARQUIS D'AZEGLIO:—

"I have used my utmost endeavours to do well what I have done; and if I have failed, let my reader reflect that even to do it ill requires care and pains, and is attended with no little difficulty."

GLOUCESTER TERRACE, HYDE PARK,
January, 1858.

PART I.

INTRODUCTION.

1. THE materials made use of by civilized nations for food, are so various and incongruous, collected from all parts of the world, and from every production of nature, that it would be quite impossible even to mention their names in a volume of this size; but fortunately, this is not required for my purpose, as the proximate principles, of which every article of food is a combination, are few in number, and the ultimate elements still less.

The Proximate Principles are those compounds to which all food may be reduced without actual chemical disintegration: thus meat may be said to consist of albumen, fibrine, fat, extractive matters, and salts; wheat, of starch, gluten, &c.; but each of these principles can be separated into their ultimate elements,—albumen into carbon, hydrogen, nitrogen, oxygen, sulphur, and phosphorus—fat into carbon, hydrogen, and oxygen; and so on. These elementary substances are, to the chemists of the present day, incapable of division, and are therefore termed ultimate, although it is probable that several of them may eventually be proved to be compound bodies.

The following table will point out at a glance the various alimentary proximate principles of which our

food is composed, as also the elements of which they are the combinations. I have divided them, for convenience of tabulation, into organic and inorganic, and these again into groups, proximate principles, and ultimate elements.

ORGANIC,	Nitrogenous, derived principally from Animal Food.	Proteine Compounds.	Albumen $C_{400}\ H_{310}\ N_{50}\ O_{120}\ S_2P$.	
			Fibrine . $C_{400}\ H_{310}\ N_{50}\ O_{120}$ S.P.	
			Caseine . $C_{400}\ H_{310}\ N_{50}\ O_{120}$ S.	
			Proteine, Oxide, Binoxide, and Tritoxide.	
		Gelatinous.	Gelatine . . . $C_{52}\ H_{40}\ N_8\ O_{20}$	
			Gelatine Sugar $C_8\ H_9\ N_2\ O_7$	
		Extractive Matters.	Soluble in water .	Nitrogenous compounds, generally coloured, found in blood, flesh, &c.
			" alcohol	
			" spirit .	
			Hematin $C_{44}\ H_{22}\ N_3\ O_6$ Fe.	
	Non-nitrogenous, derived principally from Vegetable Food.	Saccharine.	Sugar . . Cane $C_{24}H_{22}O_{22}$	The hydrogen and oxygen in these compounds are equivalent to water, and many are isomeric.
			Sugar . . Grape $C_{24}H_{28}O_{28}$	
			Acetic acid . . . $C_4\ H_3\ O_3$	
			Starch . . . . . . $C_{24}H_{20}O_{20}$	
			Gum . . . . . . $C_{24}H_{20}O_{20}$	
		Fatty.	Fixed oils .	Ultimate elements, C,H,O, the carbon and hydrogen being greatly in excess.
			Volatile oils	
			Alcohol . . . $C_4\ H_5\ O$, H O.	
INORGANIC,	Air		O.	The most important combinations:— Phosphate of Lime, Oxides of Iron, Phosphate of Magnesia, Chloride of Sodium, Carbonate of Lime, Phosphate of Soda, Phosphate of Potash, Sulphates, &c.
			N.	
	Water . . .		O.	
			H.	
	Elements combining together forming salts, found intimately united with the organic proximate principles.		Phosphorus . . . . . P.	
			Sulphur . . . . . . S.	
			Iron . . . . Fe.	
			Chlorine . . . . . . Cl.	
			Calcium . . . . . . Ca.	
			Magnesium . . . . . Mg.	
			Sodium . . . . Na.	
			Potassium . . . . . K.	
			&c.	

Upon a careful perusal of this table, it may be discovered that carbon, united with hydrogen and oxygen in various proportions, enters as an ingredient into every form of aliment; nitrogen is then added, producing another large and most important class,

which, with various additions from the inorganic kingdom, complete the list of proximate principles constituting our food.

Man, except upon extraordinary occasions, does not produce these proximate principles; he finds them ready for his use in the animal and vegetable kingdoms, and by the exercise of his faculties assists their adaptability to his system by cooking, and by this means less vital force is expended in converting them into ingredients resembling, and eventually becoming, his blood and tissues.

2. The elements which combining in ever-varying proportions, form the principles of our food, are carbon, at present believed to be a solid, and hydrogen, oxygen, and nitrogen gases. Whether gases or solids, it must be evident that they are composed of atoms, which, however minute they may be, must be appreciable, otherwise they would never form a solid, as they do by condensation.

3. In a gas, the atoms revolve round their common centre of gravity, and have but little attraction one to another; there must also be considerable space between the atoms, as atoms of other gases pass freely in between them. The atoms of a gas are mutually repulsive when brought within a certain distance of one another, and no pressure has been sufficient in the elementary gases to overcome this repulsion; but in carbonic acid gas it has been effected, and a liquid, and even a solid has been the result. The atoms of hydrogen and oxygen revolving round one another do not, under ordinary circumstances, combine; but

upon a spark of electricity being passed through them, the atoms of hydrogen expand, inducing a contrary state of contraction in the oxygen, and they immediately fly together, producing water.

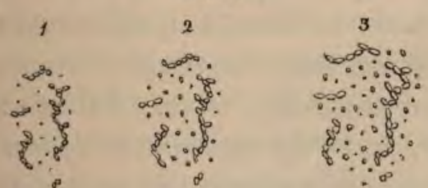
4. Now a liquid must be the result of a closer proximity to one another of the same atoms which had previously composed the gases; but the atoms are now equidistant, and their attractive and repulsive powers are in equilibrio, each atom attracting those whose poles look towards its own, and repelling those whose equators look towards its own. There must be, therefore, only two directions of attraction and repulsion in liquids, one in the direction of the polar axis, the other in that of the equator. One is therefore at right angles to the other: in all other directions they are intermediate. The liquid form is dependent upon external pressure; without it, the composing atoms would fly off as gases, or would enter into secondary arrangements, as in solids.

5. In a solid, the atoms enter into secondary arrangements with those for which they have the greatest affinity or attraction, and compound atoms are the result, certain numbers of atoms reacting amongst themselves. It is necessary to have some idea of the atoms of which matter is the aggregation before entering into the more complicated inquiries, relative to their mode of reaction one towards another, and their arrangements in organized bodies.

6. If a solution containing phosphate of lime, urate of ammonia, or any salt which crystallizes in amorphous granules, be placed under the microscope (a

drop of alkaline urine is the very best that we can use), the process of the aggregation of atoms can be watched; if an inch object-glass be used, we find that the granules of phosphate of lime appear after a little time attached one to another; if a quarter object-glass be used, the minute molecule may be observed in a state of vibration, attaching to itself atoms of phosphate of lime, beyond our assisted vision to observe; we can only see that the molecule we are watching is increasing in size, and whilst doing so vibratile motion is produced. After having completed its growth, motion ceases, and it generally becomes attached to some other granule. If instead of a quarter we make use of a sixteenth, the molecule when first observed is still more minute than when a quarter was used; hypothetically therefore, it may be supposed that if our instruments were sufficiently delicate, the ultimate atoms of matter, even those composing a gas, might be demonstrated.

FIG. 1.



No. 1. The granules of phosphate of lime (as seen by the aid of an inch object-glass) forming in urine. No. 2. The same, quarter object-glass. No. 3. The same, a sixteenth used. The most minute molecules are here detected.

7. The ultimate atoms of all matter are spheroids in a state of vibration. To prove this I shall take an atom of water as the example. Water is the result

of the union of the two gases oxygen and hydrogen: the atom of water, therefore, must contain two constituents in opposite stages of vibration, one more dense, the other less dense. Each constituent while undergoing the expanding stage must be negative, while the contracting, positive. In relation to each other, the less dense must be negative, the more dense positive: in relation to surrounding bodies, the reverse. A current must exist through the atom, passing in by the more dense and out by the less dense. So that a certain volume of oxygen gives off as much of the force while undergoing the contracting stage as double the volume of hydrogen can absorb during the expanding stage, or exactly as much as the latter has imparted to surrounding bodies during its previous contracting stage. Thus their vibratory powers must be as two to one relatively to their bulk, oxygen having double the vibratory power of hydrogen.

8. The atoms of hydrogen are least likely ever to be decomposed, having great capacity for heat, being the best known inductor, *i. e.*, will retain the state of disturbance necessary for the production of the currents better than any other. Induction and conduction are relatively opposed, the former being dependent upon the absence of atomic changes, the latter upon its presence. Oxygen comes next as an inductor, and next as regards the improbability of ever being decomposed. The influence they exert upon each other is important, being strongest as their capacities are most opposed. Thus, when hydrogen is undergoing the expanding stage of vibra-

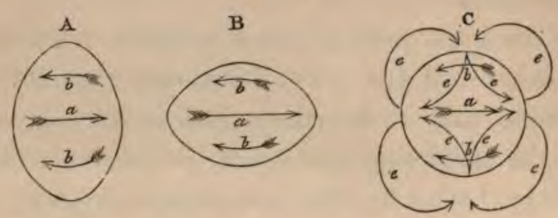
tion, and oxygen the contracting, their relative influence is most active. The oxygen in water is in a condition of greater condensation than when in aqueous vapour, for the mean specific gravity of the two constituents in the proportion in which they form water is 1·25, while that of vapour is 1·875, or half as much again. The oxygen is probably in the form of ozone.

9. The next query is, what position relatively to each other will the two constituents assume? To determine this, three considerations are necessary; first, the imparting the force or current to surrounding bodies by the less dense; secondly, the imparting the force or current from the more to the less dense; thirdly, the imparting the force or current from surrounding bodies to the more dense. The two first would be best attained by the more dense forming a nucleus, and the less dense enveloping it on every side, such being the position in which the less dense would present the greatest extent of surface to surrounding bodies, and likewise to the other constituent. But this arrangement would be inconsistent with the attainment of the third, as no force or current could pass from surrounding bodies into the more dense constituent when enveloped on every side by the less dense; this arrangement is therefore modified.

10. The spheroidal form is that which the two constituents of an atom must assume, being that best adapted to allow the three actions above mentioned to take place; the polar parts, and those

about the axis being the more dense constituent, or that by which during its expanding stage the force or current passes into the atom, the equatorial parts being the less dense constituent or that by which during the contracting stage the force or current flows out of the atom.

FIG. 2.



A. The spheroid expanding at the poles, contracting equatorially.
B. The spheroid contracting at the poles, expanding equatorially.
C. The spheroid in a state of equilibrium, prior to contraction.
a. The arrows show the direction of rotation of the spheroids.
b. The direction of the equatorial currents opposite to that of rotation.
e. The directions of the circuit of the force, both within and without the spheroid.

11. Currents in the spheroid produce rotation; rotation will continue the currents; they therefore contain within themselves the elements of their own existence. The spheroid of water is formed of a dense atom for the axis—namely oxygen—and a less dense at the equator, hydrogen; consequently, upon the application of a force, say heat, a current is induced from the denser axis to the less dense equator. The axis expanding to absorb the force, heat, and contracting to give it off to the equator, the latter expanding whilst receiving from the axis, and contracting in giving it off to surrounding bodies; they are therefore always in an opposite condition; but

the axis must absorb from the surrounding menstruum, whatever that may be, the equator imparting to the same; continuous currents are therefore always flowing through the atom.

12. If the spheroid be unattached, the currents set up rotation, and vibration is the result. If it be not free, as in a solid, where it has entered into a secondary arrangement with other spheroids, instead of the currents producing rotation, they are directed in a given route, so that by the multiplication of numberless currents, all directed towards a certain point, an appreciable force or power is generated. These currents are not continuous, but intermittent, as the spheroids have to absorb as well as to give off the force; so that to produce a continuous stream, the intermittent currents must be collected, retained, and supplied as required.

13. All matter is soluble; that is to say, there is no aggregation of atoms in which the attraction of cohesion is so great but that there is not some force which will separate the component atoms from one another. Herbart thus expresses himself:—"Matter is impenetrable only with respect to those substances which are not able to produce a change in its existing equilibrium of attraction and repulsion. Every organic body is a system of atoms, which are themselves the subjects of a system of internal states arising from the reciprocal action and reaction of the atoms on each other."

14. In organized bodies, the fluid in which the atoms are immersed is water, or the gases composing

it. Water is a combination of oxygen and hydrogen, and may be looked upon as a salt, of which hydrogen is the base and oxygen the acid. Electricity, we know, has the power of separating the gases one from another; it also has the power of combining them when separated. During the expansion and contraction of the atom, currents of electricity are generated which unite or disunite the gases composing water, the hydrogen flying to the equator of the spheroid, the oxygen to the poles. This occurs when a molecule is increasing by adding fresh atoms to itself. When a molecule is breaking up, the process is the exact opposite,—the gases are given off, forming water. Water, or its component gases, enters more or less into the formation of the great majority of atoms; and according to the mode of arrangement of the atoms, and the per centage of water, is a substance easy or difficult of disruption. Without water life could not exist for an instant; it is therefore the most important of all the alimentary principles, constituting as it does three-fourths or more of every living thing. It is not only, however, as water alone that it is so useful, but as the reservoir for the gases hydrogen and oxygen, which it renders itself up as, during the various atomic changes hitherto to be described. Another important property of water is its ability of absorbing its own bulk of carbonic acid gas, also an excess of oxygen over the amount found in the atmosphere. The blood has the same properties in this respect that water has, only in a higher degree.

15. The formation of a solid by the aggregation of the component atoms of a gas is beautifully demonstrated in the cells of the leaf. Through the minute pores carbonic acid gas is absorbed, and in the cell it meets with the water, salts, and organic matters of the sap. By the aid of the microscope we are enabled to observe currents in various directions circulating in the fluids of the cell. At length a minute vibrating molecule appears; it increases in size, and completes its growth, when motion ceases; others in the meantime have become visible, and going through the same process, attach themselves one to another in little masses. These, chemists tell us, are granules of starch, formed of carbon, hydrogen, oxygen, and salts, the carbon derived from the carbonic acid gas absorbed from the atmosphere. In the same manner all the complex substances found in the vegetable kingdom are formed: the materials are absorbed, they are broken down into their ultimate atoms, from which fresh combinations are produced, resembling those of the cell in which the process is carried on.

16. All these combinations and disruptions take place through the agency of what is termed vital force, which I prefer calling in this position, cell force, or cell electricity. Vital force is merely a modification of that remarkable fluid pervading all matter and all space, always aiming at equilibrium, and yet so easily disarranged. No change of any description can take place in matter without causing currents of this fluid to flow in different directions: it is these currents that produce the various chemical changes

within the cells; again the chemical changes give rise to fresh currents, so that action and reaction are continually going on. These chemical changes are new arrangements taken by the ultimate elementary atoms of matter in reference to one another, by which new principles are produced out of the same elements, differently arranged. Thus chemists have discovered, that two substances may contain exactly the same elements in the very same proportions, and yet, from the atoms being differently arranged, they may have very different properties. The great importance of the mode of arrangement of the atoms must be apparent.

17. The form of electricity termed cell force is found in a very high degree in the cells of the blood and tissues of animals, and it is by the agency of the cells that all the wonderful chemical and mechanical changes are effected, by which the food which enters our stomachs is, after having passed through many transformations, converted into the living tissues of our frames.

ALIMENTARY PROXIMATE PRINCIPLES.

18. The most important group of alimentary proximate principles that we are accustomed to make use of as food, are the proteine compounds, because they most resemble the materials of our organism; they are principally derived from the flesh of animals, but they are also found in vegetables under the name of gluten. These compounds are termed vegetable and

animal albumen, fibrine, and caseine, with the proteine oxides—ill-defined substances, extracted from flesh, blood, &c. These are the most important nitrogenized substances, and serve to form the bulk of the muscles and other tissues, and are generally easy of conversion, from their close resemblance to the tissues into which they are changed. The formula for proteine is $C_{41}H_{31}N_5O_{12}$; and the compounds derived from it differ but very slightly.

Albumen contains two atoms of sulphur and one of phosphorus more than proteine—is soluble in water, but coagulates at a temperature exceeding 167° Fahrenheit; it is associated in the tissues with phosphate and sulphate of lime, and chloride of sodium. In solution, it is not precipitated by acetic acid. Corrosive sublimate and nitric acid throw down copious deposits.

Fibrine contains one atom of sulphur and one of phosphorus more than proteine; it is fluid in the blood, but coagulates spontaneously upon withdrawal from the circulation. It is always associated with a certain amount of fat, and phosphate and sulphate of lime; it is insoluble in water, but soluble in dilute acetic, hydrochloric, nitric, and sulphuric acids, potash, and ammonia.

Caseine contains one atom of sulphur more than proteine, and is associated with phosphate, carbonate, hydrochlorate, and sulphate of lime, magnesia, and iron; it is soluble in water, but is not coagulated by heat. It is precipitated in solution by all acids, although soluble in an excess.

These principles are easily converted one into another in the system, and appear to differ principally in the substances with which they are associated. Thus, proteine is the root: proteine and soda salts, albumen; proteine, fat, and lime salts, fibrine; proteine, magnesia, lime, and iron salts, caseine. Gelatine is not found in the animal tissues, but is extracted from most of them by boiling; it appears to be formed from the proteine compounds by oxidation; it is easily precipitated when in solution by tannin, and gelatinizes on becoming cold. The extractive matters appear all to be nutritious, and convertible to the uses of the system.

19. *Saccharine Substances.*—This large class of alimentary principles are almost exclusively of vegetable origin, and constitute the chief food of mankind. They are compounds of carbon, hydrogen, and oxygen, the two latter in the proportion to form water; many are easily convertible one into another. The most important of these is starch, $C_{24}H_{20}O_{20}$, found in wheat, peas, beans, potatoes, &c., which are so sought after as food, not only by man, but many animals. Starch consists of microscopic granules of different sizes, from the most minute upwards; each granule is enveloped in a thin skin, insoluble in cold water, but acted upon by boiling water; all starch should therefore be boiled before used as an aliment: it is converted in the intestines into sugar by combining with the elements of water. Cane-sugar, $C_{24}H_{22}O_{22}$, is much used as an article of diet, and is easily converted in the healthy stomach into lactic

acid, $C_{24}H_{24}O_{24}$, by uniting with water. Lactic acid is changed into the acetic by oxidation, and their salts into carbonates by heat, &c.

20. *The Fatty Matters* may be represented by the formula $C_{37}H_{36}O_{5}$, the carbon and hydrogen being greatly in excess: they are a most important ingredient of food, being only second to the proteine compounds. Animal oils are much more nutritious and adaptable to the wants of the system than vegetable. Alcohol is of a fatty nature, and a frequent article of diet, being stimulant, and, where not habitually used, is one of our most useful medicines.

21. From the inorganic kingdom we derive the various salts found in the body, as well as the gases, oxygen and hydrogen; the salts are combined with all the proximate principles except the fats when pure. The most important salts are found in the table, but there are many others in the body—I believe, however, generally accidentally, and not as a necessary ingredient; thus arsenic, lead, nickel, &c., are said to be found in the fluids, and even in the solids.

22. Phosphate of lime is a constituent of almost every form of animal or vegetable principle, and exists largely in the bones of animals, in the blood, in grains of starch, &c. In a full-grown adult the mineral matter entering into the formation of his body has been computed at ten pounds; out of this the phosphate of lime weighs nearly eight pounds; the next in quantity is the chloride of sodium, which constitutes more than half the remainder. The iron

is an exceedingly important inorganic material of the body, and is found principally in the coloured portions, especially the blood.

23. Having thus briefly enumerated the chief proximate principles of our food, I shall now proceed to describe their gradual transformation into the materials suited to build up the various portions of the body. To do this I must take each process separately; at the same time, it must be remembered that all the wondrous chemical, catalytic, and mechanical processes going on in the system are only portions of one beautiful whole; and that though we are obliged to study them separately, they should be looked upon as one and indivisible; that the slightest change in one process causes a corresponding one in another; that action and reaction balance in the most perfect and beautiful manner; and however complicated the methods seem, they are in reality of the greatest simplicity, each one following the one preceding it as its consequence. The uniformity of working being thus provided for, the different processes are carried on with the greatest regularity; and except from external causes, would proceed day by day, from the cradle to the grave, at an advanced age; but the external influences are so varied, so contradictory, and in many cases so inimical to a normal action of the vital function, that the system yields reluctantly to their baneful effects.

24. THE PROCESS OF DIGESTION

May be considered to commence in the mouth; for the division of the food by the teeth and its intimate mixture with the saliva, is of the greatest importance. Digestion is the reduction of the food into its lowest forms, by mixture with water and other principles hitherto to be described; thus albumen, fibrine, and caseine—principles resembling the materials of the body they are meant to nourish, by division, mixture with water, and the presence of a peculiar animal ferment—are reduced to a low type of proteine, bearing no resemblance to the higher forms in their properties, although at the same time composed of the same elements. Water is the chief agent used in all these lowering processes; solution is required to bring all the ingredients together, and to allow their free action one upon another; and water is called upon to aid the concoction, to use the old word.

25. Even the saliva contains less than one per cent. of solid matter, 99 parts being water: it is a viscid opaline fluid, having a faintly alkaline reaction; the salts—about half per cent.—resemble those found in the blood; the organic matter consists of a little free albumen, mucus, epithelium scales, and a peculiar principle called ptyaline, insoluble in alcohol, —this is a nitrogenous substance, and acts as a ferment, it being itself in a state of change; it has the property of changing, even in the laboratory, boiled starch into sugar; in comparison with proteine, it

contains an excess of nitrogen, and a deficiency of oxygen; when freshly secreted it is in solution; it rapidly combines with oxygen, for which the saliva has a great affinity, absorbing as much as 2¼ times its bulk (Dr. Wright), that, however, being more than the average. The oxygen absorbed by the saliva increases the fermentative power of the ptyaline, hastening the process, as otherwise it would have to decompose the water—a work of time. The chewed food being mixed with the saliva, the mass is passed down into the stomach, to which (from the stimulus of the presence of food) a larger flow of blood is attracted, and a healthy, or normal local congestion is the result.

THE STOMACH AND GASTRIC SECRETION.

26. The healthy *empty* stomach is lubricated by a faintly alkaline mucus, which covers the surface of the villi; but upon digestion commencing, or upon the sight of food, or when the nervous system is aware of a want for new aliment, it expresses its desire by the decomposition of chloride of sodium in the capillary circulation of the stomach, and the secretion of hydrochloric acid, which, uniting with the mucus on the surface, reacts on the sentient nerves of the stomach, giving rise to the sensation of hunger. The decomposition of chloride of sodium can be effected in the laboratory by the aid of electricity: in the stomach, in the minute capillaries, the nervous fluid acts upon the chloride of sodium in precisely

the same manner; chlorine is freed, eventually becoming hydrochloric acid; the soda, combining with an acid, sometimes phosphoric, sometimes lactic, is absorbed, and passes on to the liver.

27. Acid appears to be secreted but slowly by the stomach, and does not counteract the conversion of starch into sugar, for some considerable time after food (composed of mixed aliments) has been taken; for if regurgitation should take place during the first half-hour after a mixed meal—the time being more or less, according to the amount of starchy or proteine aliment partaken of—the regurgitated fluid will have a sweetish taste, and the reaction alkaline, neutral, or but faintly acid. However, as digestion proceeds, more acid is found in the stomach, the lactic being generated.

28. A peculiar nitrogenized ferment, termed pepsine, is also secreted by the mucous membrane of the stomach: this is found united with the acid; its formula, according to Vögel, is $C_{48}H_{32}N_8O_{10}$, which, on comparison with proteine, contains less oxygen and hydrogen, and more nitrogen; therefore, to become proteine, it must attach to itself the elements of water, and give up nitrogen—this it immediately proceeds to do. One of the properties of chlorine is to disengage nitrogen from all substances in which it exists, either in large quantities or loosely combined; in pepsine the nitrogen is loosely combined, ready to be given off. Chlorine in small quantities, in a continued supply, is disengaged from the chloride of sodium in the blood, the chloride of sodium in the

food being absorbed to repair the deficiency; the chlorine having set free the nitrogen from the pepsine, combines with hydrogen and water to form hydrochloric acid.

29. We have now in the stomach with the proteine compounds sugar, which the saliva has changed the starch into; pepsine, progressing towards proteine by the disengagement of nitrogen and combination with water, oil, and salts; and a little hydrochloric acid; with indigestible matter. In the healthy stomach, the sugar that has been formed from the starch by the aid of the ptyaline of the saliva, is now prepared to undergo a change into whatever ingredient may be required by the wants of the system; it may be converted into a fatty principle; or an acid, as lactic acid; or a proteine compound, by combination with oil and the nitrogen which has been freed from the pepsine by the chlorine. In fact, the stomach has the power of combining the starchy and oily ingredients into any particular form required by the organism, and the want is expressed by the nerves. The fixing of nitrogen is one of the most important functions of the stomach, and the inability to do this one of its most distressing ailments, as will be explained hereafter. Where the sugar is not used for the formation of a fatty or proteine compound, it is converted into lactic acid, which, combining with a base for which it has an affinity, is absorbed as a lactate; much free acid, however, is passed into the duodenum, and lactic acid may form a portion of it, and frequently a very large proportion. Occasionally

the nitrogen given off, instead of being fixed, is converted into nitric acid, which, acting upon the saccharine element, converts it into oxalic acid.

30. The animal ferment now proceeds to reduce the proteine compounds by intimate mixture with water, and whatever acid may be free in the stomach, to a principle very much resembling proteine; the disengaged phosphorus and sulphur uniting with oxygen and bases, forming salts. The oil, very finely divided, is intimately mixed with the former ingredients; the earthy and other bases are combined with the acids which have the greatest affinity for them; and as both the bases and acids are variable, they are not always uniform: the phosphate of lime, phosphate of magnesia, and chloride of sodium are always present in solution in the acid chyme. The vessels in the walls of the stomach have absorbed many soluble matters; gelatine, alcohol, some sugar, the excess of water taken with the food, and some salts, enter the circulation, and will be noticed when speaking of the liver.

31. The rough sketch I have presented, will give but a very faint idea of the beautiful and complicated chemical, mechanical, and electrical processes going on during digestion; but if this were fully entered into, the mind of the author and that of the reader would become so bewildered that no useful object would be attained. I have related here merely the principal and most important changes produced during healthy digestion; the more precise changes, at the present state of our knowledge, cannot be

given, and in all its minutiæ probably will never be ascertained; for even if healthy digestion be accounted for, the thousands of forms of mal-digestion never can be arrived at, for each individual has his own peculiar deficiency. Thus, for example, the salts in the stomach are perhaps never for five consecutive minutes the same. As digestion proceeds a new acid is generated; it seizes upon a base to which it has the greatest affinity; the acid, set free, looks out for another base, and so on; and this is continually taking place during digestion. The chyme, when passed through the pylorus, consists chiefly of a low form of proteine, oil very finely divided, some lactic, hydrochloric, and other acids, some starch and sugar, various salts, and indigestible matter, lignine, rinds and seeds of fruits, &c., in an excess of water. Upon entering the duodenum, it meets with the pancreatic fluid and the bile.

32. THE PANCREATIC SECRETION

Somewhat resembles the saliva: normally it is faintly alkaline, and contains a nitrogenous ferment, pancreatine, which probably acts upon the starch yet unchanged in the stomach. It is supposed also by some physiologists to assist in emulsifying the fats; but in some recent experiments undertaken in Paris, in which the pancreatic fluid was drained off externally to the body, the chyle was found to contain the normal quantity of emulsified fat. The alkalinity of the pancreatic secretion, and more particularly that

of the bile, arrests the fermentation (commenced in the stomach) of the proteine compounds by neutralizing the free acids. The province of the pancreatic secretion, amongst others, seems to be the conversion of the starch which has escaped unchanged in the stomach into sugar, and also, by mixing with the bile and the mucus thrown out by the innumerable glands of the small intestines, to assist in the change of chyme into chyle. The pancreas is large in the herbivora.

THE BILE.

33. In the preceding description of the process of digestion, it may be perceived that the stomach has secreted, and removed from the blood a large quantity of nitrogenized matter,—much chloride of sodium has been disrupted, the chlorine being removed, the sodium combining with oxygen, and probably lactic acid remaining in the circulation; this blood is, consequently, unfit for the proper nourishment of the body, it is therefore all collected, and passes through the liver before again entering the general circulation. The portal vein receiving from all the viscera the blood which has given up so much during the process of digestion, has also a fresh supply of ingredients, which it has absorbed from the new aliment: it differs very materially from ordinary venous blood; upon examination and comparison it is found to be darker—it coagulates more slowly; upon resting, a film of dark-coloured fat collects upon the surface, impregnated with the colouring matter of the blood. There

is also an excess of colouring matter in the blood-corpuscles themselves, as has been shown by Schultz and Simon. The portal blood contains many ingredients of the food which have been taken up by the circulation in the stomach and intestines on account of their ready solubility,—water, alcohol, salts, sugar, gelatine, &c.

34. Upon entering the liver, these various ingredients immediately undergo a change, but this change cannot be dogmatically put down upon paper, saying, " This is what goes on in the liver, never mind what are the wants of the system, what the materials upon which it is to act, what the conditions of the atmosphere, temperature, &c." No; the liver is an organ which has the power of secreting, in health, the exact desideratum required by the wants of the body, and is a complementary secretion to that of the stomach and intestines. It is also subservient to the wants of the lungs, skin, kidneys, &c. For instance, as Messrs. Becquerel and Rodier beautifully observe, " The liver secretes sugar under the influence of the respiratory apparatus. The lungs, stimulated by the action of the inspired air, react upon the nervous centres, which reflect such action (stimulus) back towards the liver, through the medium of the spinal cord and great sympathetic nerve. Experiments prove that by direct irritation of the great sympathetic nerve it is possible to produce a hypersecretion of sugar on the part of the liver. The more an animal breathes, the more oxygen does it consume, and the more sugar does it produce. The action of the respiratory

apparatus upon the liver presents all the characteristics of a reflex act." The secretion of bile, again, takes place according to the amount of pepsine secreted in the stomach, according to the amount of fatty secretion of the skin, according to the amount of colouring matter, uric acid, &c., excreted by the kidneys; it is, therefore, determined by every organ in the body. Even the muscular system reacts upon the secretion of the liver, and by waste of substance sends materials by the hepatic artery for conversion, either into an excretion or secretion.

35. The portal blood, upon entering the vessels of the liver, bathes the secretory cells; and these absorb, under nervous influence, the ingredients required for the use of the lungs, the further wants of digestion, and for the healthy depuration of the blood. Bernard has proved that the liver secretes a large proportion of sugar, and that this is a constant duty of the liver; whereas the secretion of bile is probably intermittent, depending a good deal upon the food taken. Bernard also states that whatever the food partaken, still sugar is secreted in the liver. This sugar cannot therefore be a vegetable sugar, but an animal one; and it is so, namely glycocoll; which can, even in the laboratory, be separated from gelatine by boiling with a caustic alkali. But Bernard further states that grape sugar in a considerable amount can be extracted from all healthy livers; this must be from a further change of the glycocoll into grape-sugar and urea; thus two equivalents of glycocoll equal one of grape-sugar plus two of urea—

$$2\,(C_8H_9N_2O_7) = C_{12}H_{10}O_{10} + 2\,(C_2H_4N_2O_2).$$

Lehmann has also found a notable quantity in the hepatic vein, but none in the portal.

36. The bile, which doubtless is being secreted at the same time as the sugar, does not pass directly into the intestines, but is diverted into the gall-bladder, where it remains until the stimulus of food in the duodenum causes it to flow out. It is an exceedingly complex fluid, and very difficult to obtain in its purity: it probably has never been thoroughly examined: it consists chiefly of an oily resinous matter combined with soda, and is of an alkaline reaction; it has a peculiar power of emulsifying the fat found in the duodenum; it rapidly decomposes, some of its constituents being re-absorbed into the blood and some passing off by the bowels, mixed with the fæces; it contains little nitrogen, its formula resembling the fats. There is no analysis of bile that can be perfectly relied on. The portal blood, as I have before stated, contains much fatty matter. Fat is composed of fatty acids, combined with a base termed glycerine, which is sweet, and perfectly soluble in water. In the liver, that which is performed in the laboratory is beautifully carried out in the minute microscopical secretory cells. The peculiar sugar glycocoll is separated and passes on to the hepatic vein, either as such or as grape-sugar and urea; and the fatty acids, combining with the soda which has been set free in the stomach and the colouring matter from the broken-up blood cells, constitute the bile, and is taken up by the bile ducts.

37. The hepatic artery also supplies blood to the liver, first for its nourishment, and secondly, bringing much oxygenized waste tissue for excretion. The oxygen of the blood brought by the hepatic artery combines energetically with some ingredient in the portal blood rich in carbon; for Bernard has proved that the temperature of the blood in the hepatic vein is nearly a degree higher than that in the portal vein, and two degrees higher than that in the hepatic artery, the blood in the portal vein being 102°.92 Fahrenheit. This combination has doubtless taken place between the lactic acid and the oxygen; acetic acid, alkaline carbonates, and water, being the result. These ingredients will be traced further when speaking of the blood in the lungs. The excess of colouring matter before spoken of as existing in the blood of the portal vein is not found in the hepatic blood, showing that it has in the hepatic cells combined to form the colouring matter of the bile.

38. The various and contradictory analyses of the bile I shall not attempt to state. M. Demarçay describes it as a choleate of soda, and this is the most simple, as perhaps the most correct, term for it. In conjunction with this simple organic salt, if I may be allowed such a term, are found many other substances, such as cholesterine, oleate and margarate of soda, salts of potash, ammonia, magnesia, &c. Berzelius states that there are two distinct colouring matters mixed with the bile, yellow bilifulvin and green biliverdin. These probably are merely different states of oxygenation of the same substance; for

upon combining oxygen with the yellow bile of the carnivora it becomes green, and by separating oxygen from the green bile of the herbivora it is yellow. As we have seen that much nitrogen has been removed from the blood in the stomach, we now find that the liver removes much carbon, by which the balance is properly arranged, and the blood passing from the liver may be considered to resemble very much ordinary venous blood; it however contains sugar, which will be afterwards accounted for.

39. Some constituent of the bile may also combine with any pepsine which has not been disintegrated for the reduction of the proteine compounds, together forming albumen, taken up by the lacteals. The bile has many functions; amongst others, it acts as a stimulant to the absorption of fat by the lacteals; it arrests fermentation commenced in the stomach, and putrefaction, which would otherwise take place in the intestines; it stimulates the peristaltic motion of the intestines; it undergoes further changes upon absorption; and if it be prevented from entering the intestine, the animal soon wastes, and death rapidly ensues.*

40. The chyme in the duodenum having been intimately mixed with the bile, pancreatic fluid, and the secretions of the lining membrane of the intestines, is now neutral, or possibly slightly alkaline, and the further digestion of starchy matter proceeds, the lacteals being actively engaged in absorbing nutritive fluids from the chyme as it passes. On entering the cœcum, a second acid secretion is poured out,

* Schwann.

and any proteine compound that has escaped solution in the stomach is here dissolved. On passing onwards, the lacteals absorb all the matter that is capable of entering into the formation of the blood, and in the large intestines much waste matter is poured out to mix with and aid in forming the fæces.

THE CHYLE.

41. This fluid is of the greatest importance, for on its normal elaboration depends the new blood, which is to nourish and form the body. I shall boldly give my views concerning the formation of the chyle, for upon them is principally based the further reasoning on the physiology and pathology of the affections of which I treat; and if what I bring forward is novel, let the evidence of its truth be examined into before it is set aside. In these days of progress, a discovery or invention, however contrary to received views it may be, is still looked upon with respect until it is proved to be unworthy of acceptance. We are not living in the days of Harvey, of Jenner, or of Hewson, those shining lights who dazzled their fellow-mortals from their great superiority to their contemporaries, but in days when hundreds of good men can examine into, and are capable of forming a correct judgment of any discovery, be it mechanical, chemical, microscopical, or purely theoretical. I trust, therefore, that I may not be judged by preconceived notions, but by the correctness or incorrectness of the various steps of my reasoning, and the data upon which they are based.

In a work of this description I am unable to give my observations and experiments in their minutiæ; although I trust some day to be allowed that opportunity, but merely their results; but it is my desire to make every step as clear as possible without unnecessary verbiage.

42. Chyle is the fluid found in the lacteals, and is absorbed through innumerable villi in the mucous membrane of the intestines from the chyme as it passes over them. The principal ingredients of the chyme as it passes from the stomach are, an acid solution of a proteine compound, phosphate of lime and magnesia, and various other salts, starch in one of its various forms, sugar, lactic acid, &c., and oil finely divided and distributed in the fluid. The pancreatic secretion and the bile, to a great extent neutralize the acidity of the chyme; but the villi of the lacteals are bathed in an acid fluid, secreted by the minute glands of the mucous membrane,* so that the phosphates of lime and magnesia are retained in solution; this solution of phosphate of lime and magnesia is absorbed by the lacteals, together with the peculiar proteine compound of the chyme and the minutely divided oil. The action of the cells surrounding the termination of the lacteals is described by Professor Kölliker, and is doubtless known by most physiologists. The oil during digestion is found in minute drops in these cells, from whence they pass into the canal of the lacteal.

43. The chyle has an alkaline reaction, and the

* Simon.

phosphate of lime (taking that as the type, the phosphate of magnesia, &c., acting in the same manner throughout) immediately commences to crystallize. Now the mode of crystallization of phosphate of lime (as seen by the aid of the microscope) is peculiar: unlike crystals with regular angular forms, which increase sliding, as it were, through the saturated solution; they increase during vibration up to a certain size, when they become stationary, attaching themselves to other formed granules: these crystals are never angular, but of a rounded oval shape, thus showing their alliance to the organic kingdom. Our microscopes are unable to show the earliest crystallization of the phosphate of lime, but with a powerful sixteenth, by Powell, I have seen them vibrating when they have been too minute for measurement. (See Fig. 1.) Upon entering the lacteal, the phosphate of lime commences vibration; but being in a fluid that is denser than water—in fact, a solution of proteine and oil—each crystal becomes coated with a portion of these ingredients, vibration continuing; when many of these molecules are formed, they, upon approaching one another, become attached in a line, like a small string of beads, vibration still continuing; when a certain number are thus joined they double one upon another, forming a nucleus, to which minute atoms are continually added until a tolerable aggregation is the result: this is a mass of molecules. The external atoms now proceed to form a cell-wall, which in this period of its existence is completely invisible; but it consists of minute atoms, between

which are still smaller interspaces, which admit of the passage of fluids; within the cell atoms are discovered, but separated from one another, and in active vibration; they appear to be undergoing some change, many fresh ones appearing, and the cell increasing in size.* These cells are found in large quantities in the chyle which has passed through the glands, and doubtless the glands have some peculiar power in aiding their formation, probably by the supply of nerve force, also by removing the water which separates the minute atoms from one another, and thus bringing them in closer apposition.

44. In the circulation of the chyle in the mesentery, the nuclei can be observed by the aid of the microscope in the lacteals immediately on leaving the bowel. These I believe to be formed in the glands of the Peyerian patches, as it can hardly be supposed that in the short distance from the villus to the edge of the mesentery (and at the rate the chyle flows, which, although much slower than capillary blood, is still constant and steady), they can be developed. Kölliker says, "The number of lacteals which may

* I have never been able to discover with the microscope the cell-envelope in its earliest stage. In fact, in very young cells, as seen in the ova of reptiles or birds, the cell-wall can only be proved to be present by the contained vibratile molecules being evidently enclosed within a boundary; but in the older cells with walls having a double contour, when breaking up, as may be seen before the bursting of the white globule of the blood, the cell-wall gradually separates into many vibratile molecules which diminish in size until they disappear in solution.

The whole microscopical process as here described for the chyle-cell, may be easily demonstrated in the formation of the cells of many algæ.

be traced during digestion from the Peyerian patches, is greater than that in other parts of the intestine, although their villi are fewer and less developed." Brucke affirms "that there is a direct communication between the follicles and the lacteals." The contents of the follicles are (Kölliker) "soft and greyish (never milk-white). They become slowly diffused through water, and consist of a little fluid, with innumerable nuclei and round cells, which, when recent, appear quite homogeneous and of a dull grey colour, but are first cleared up, and ultimately destroyed by the action of water and of acetic acid, the nuclei at the same time becoming granular and very distinct. Among these elements, which here and there also contain fatty granules, and which, as the comparison of their various forms shows, are constantly undergoing progressive and retrogressive development."

45. The first change produced by this process in the chyle is that of the proteine compound into albumen; this is effected chiefly by the removal of the excess of water bringing the atoms in closer apposition, the change being a physical rather than a chemical one,—the next to be noticed is the gradual disappearance of the oil, and the formation of fibrine. Fibrine is found in the plasma and in the cells, and is a higher form of albumen, and the material from which most of the structures of the body are eventually formed. The study of fibrine, then, is of the highest importance, and, if properly understood, will make clear the chief secrets of the organism. Fibrine first appears in the lacteals upon entering the glands;

but it is not here completed, for the clot produced is of a gelatinous character, of no great tenacity, and soon falls to pieces. The phosphate-of-lime atoms, surrounded with albumen and oil, when removed from the lacteal (the walls of which, intimately connected with fibres of the sympathetic, exert a certain and powerful influence over their further preceedings), immediately approach each other, gathering together, and removing by pressure the atoms of water from between them. This takes place more rapidly if evaporation is going on, but if not it still continues, only more slowly. The atoms of fibrine in the lacteals in this position are not completed; they therefore do not attract one another so forcibly as the atoms of fibrine removed from the capillary circulation. It is these atoms of fibrine from which the chyle-cells are formed, and also into what they break up, as will be shown when speaking of the blood. As I have before observed, the ultimate atoms of fibrine are not demonstrable with the highest powers of the microscope, but during coagulation, when many are gathered together, they may be distinctly observed, especially around any cells that may be floating in the plasma. The fibrine in the plasma consists, therefore, of immense numbers of atoms of phosphate of lime, surrounded by albumen and oil, and in the circulation mutually repellent, except when forming cells; this repulsive property appears to depend upon the influence of the nerves, transmitted by the walls of the vessels. Upon entering the glands—situations where blood and nerve force

are brought to bear upon the flowing chyle—all these processes I have described proceed more rapidly; the atoms of fibrine are of a higher character, the formation of nuclei, or aggregations of atoms, proceed more rapidly, and the nuclei quickly form cell-walls around them.

46. Upon its exit from the gland the characteristic chyle-cell may be seen; it is a globular cell of about the $\frac{1}{1400}$ of an inch in diameter, colourless, and containing numberless active vibratile molecules, which appear like black specks, and resemble in their movements a disturbed ant's nest. As the chyle-cell advances it becomes less in diameter, and the vibratile molecules gradually disappear, until the cell is eventually a pale, clear, apparently homogeneous globule, and is thus poured into the circulation.

47. What I consider to have taken place is as follows. Becquerel and Rodier thus describe pure chyle (before entering the thoracic duct):—"It is an opaque white lactescent fluid; it is not coagulable, and when found to possess that property it must be attributed to the admixture of a certain quantity of lymph." "The microscope shows, 1st, spherical particles of exceedingly small dimensions, resembling fine dust; 2nd, larger globules, resulting from an agglomeration of the elementary particles; they are round and clearly defined, almost transparent, and vary in diameter from 0·006 to 0·01 of a millemetre ($\frac{1}{6500}$ of an inch, Müller, $\frac{1}{7199}$, Prevost and Dumas). They are granular, and it is even possible to discern the manner in which they agglomerate together.

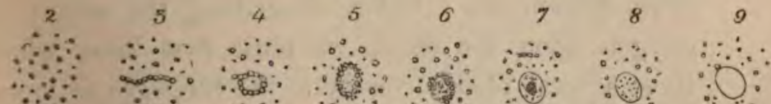
As both the molecular granules and the complete globules are dissolved by ether, it is evident that they are composed of fatty matter." I quote the above, as it bears out fully, as far as it goes, my own observations upon the chyle; and it is satisfactory to have such great names to support my views, even if it be only one step in the process of the argument. This finely molecular cytoblastema, consisting of (atoms of phosphate of lime and magnesia, enveloped by oil and albumen, the oil probably in the condition of an acid chemically combined with the albumen and salts. Berzelius says, "The ash of fibrine consists of phosphates of lime and magnesia, and a trace of iron. The components of the ash cannot be extracted from the fibrine before combustion by acids, and appear, therefore, to have entered chemically into its composition, and not merely mixed with it") numberless nucleoli, attaching to themselves others to which they have an affinity, become by aggregation nuclei, and are sufficiently large for measurement. The cell-wall is next developed, by the juxtaposition of such minute atoms that they are invisible; but it expands by the continual interposition of new atoms between the interstices of the old ones. The membranous wall of the cell differs in its chemical properties in different kinds of cells, and even in the same cell it varies in chemical composition at different periods of its growth. The nucleus separates by degrees into its component atoms, during which process vibration of the atoms within the cell is seen.

48. In the formation and destruction of all animal matter, vibration among the atoms is always demon-

strable by the microscope. It is therefore not always certain, when vibration is discovered, to what category it belongs; but, in completion, the atoms increase in size, and become attached one to another; in disruption the atoms decrease, and gradually disappear. Water, or its component gases, is the means by which this vibratile action is produced; in completion, water, or one or both of its gases, is added to the increasing molecule; in disruption, water, or one or both of its gases, is separated from the molecule: the other atoms forming the molecule being broken away by the separation of the interstitial water, the attraction and repulsion produced by these separations of atoms cause the peculiar vibration seen in the molecules of organic matter.

The cell is now perfectly pellucid, and apparently homogeneous, and is thus poured into the circulation: it has doubtless undergone various chemical changes during its onward course, and is now ready to be converted into the blood-cell, as will be shown when speaking of the blood, also its mode of reaction to different tests.

FIG. 3.



The formation of the chyle-cell.—No. 1. Molecular matter of the chyle, consisting of atoms of phosphate of lime enveloped by oil and albumen, in active vibration. 2. The same, increased in size. 3. Attaching themselves one to another. 4. Forming a loop. 5. And gradually, by the addition of fresh atoms, producing a nucleus. 6. The external layer forms an envelope, which at first is so delicate as to be invisible. 7. The molecules now begin to separate themselves from the nucleus. 8. And, in active vibration, gradually disappear by division in solution. 9. Forming the completed chyle-cell.

49. The chyle, when poured into the circulation, consists of the chyle-cells, floating in a serum containing the atoms of fibrine. The fat has almost entirely disappeared; albumen has increased from 27 in the 1000 in the lacteals before entering the mesenteric glands, to 64 in the thoracic duct, at the expense of a peculiar proteine compound absorbed from the chyme. The water is less, and the serum much resembles that of the blood. The chyle is poured into the right side of the heart, and it there meets with the blood that has passed through the liver.

50. THE BLOOD,

Out of which all the tissues are formed, and from which the secretions are derived, is a most complicated fluid, and will require all our best attention to understand some few of its properties. In the right side of the heart is collected the blood which has passed through the capillary system of the whole body, returning laden with effete matter collected during its progress, the chyle and lymph serving for new materials, and the blood which has passed through the liver, spleen, &c. Before describing the action of oxygen upon the blood, we must first know what these several bloods convey to the lungs, so as more fully to understand the process. Ordinary venous blood contains carbonic acid gas absorbed in the serum, it also brings the results of destructive assimilation, the altered albumen and fibrine, which has been used in the formation of the tissues, and which is returned in the veins not as such, but as kreatine,

gelatine, uric acid,—as various salts, carbonates, lactates, acetates, &c., ready for combination with oxygen, either to be discharged as watery vapour and carbonic acid, or by oxidation to be prepared for excretion by the various glands. The chyle I have before described, bringing fresh albumen, fibrine, salts, and the chyle cells. The hepatic vein brings glycocoll or grape-sugar, lactates and carbonates, and a nitrogenized compound, always associated with lactic acid an oxide of proteine, and in the analysis of blood described under the head of "Extractive matters." There are also many fatty matters which are separated from the fibrine during assimilation; they are termed seroline, cholesterine (removed by the liver), margaric, stearic, and oleic acids, combined with soda.

51. I think it would be advisable in this position to give an analysis of the blood, the most recent being that by Messrs. Becquerel and Rodier:—

Analysis of 1000 *Parts of Blood.*

Specific gravity of blood	1060·00
Water	781·00
Globules	135·00
Albumen	70·00
Fibrine	2·50
Fatty matters, extractive, and free salts	10·00
Phosphates	0·55
Iron	0·35

Analysis of 10 *Parts of Fat, Extractive, and Free Salts.*

Fats	1·550	Seroline	0·025
		Cholesterine	0·125
		Soap	1·400
Salts	6·00	Chloride of sodium	3·5
		Soluble salts of soda	2·5
Extractive matters			2·450

Analysis of 1000 *Parts of Serum.*

Specific gravity	1028·00
Water	908·00
Albumen	80·00
Extractive, fat, and free salts	12·00

52. Mitscherlich, Gmelin, and Tiedemann, "suppose that by the free contact of the blood with the air during respiration, acetic acid is generated, which decomposes the alkaline carbonates of the venous blood, and sets free carbonic acid; and that the oxygen of the inspired air unites in part directly with carbon and hydrogen, forming carbonic acid and water, and in part enters into combination with organic compounds contained in the blood; the result of which is, that organic products which are necessary to life, are produced, and at the same time other organic substances are converted into lower organic products, such as acetic and lactic acids, which decompose a part of the carbonates contained in the blood, and expel the carbonic acid into the air-cells of the lungs."

53. The amount of free carbonic acid in venous blood that can be separated by agitation is, according to Lehmann, 70 in 1000, but by the addition of an acid 300 per 1000 can be separated, showing that there is a very large percentage of carbonic acid combined with bases as carbonates, much of which is separated in the lungs: a free acid is required for this, and that the acetic is the one, I think I shall be able to prove by its action upon the chyle-cell.

54. The glycocoll formed by the liver, or its complementary products, grape-sugar, &c., combines with

oxygen and is given off as carbonic acid; the lactic acid, by oxygenation, is changed to acetic acid and water. Properly diluted acetic acid produces within the matured chyle-cell the free cellæform nucleus of Wharton Jones; in other words, the young blood-cell. The young cell (escaping from the old cell, which melts down in the serum) absorbs within itself the proteine oxide, associated with the lactic acid, and some fatty matter, which, together with the iron already within it, constitutes hæmatin, the colouring matter of the blood-cell.

55. *Experiment.*—If a drop of blood from the right side of the heart of an animal recently killed be dropped into a little water upon a slide, and placed beneath a quarter object-glass of a good microscope, the pale globules will be seen in large numbers, they are at first perfectly transparent, but soon minute molecules will appear in active vibration,—never resting, always changing, they increase in number and in size, and gradually form in the centre of the globule an irregular mass or ring of molecules; very dilute acetic acid hastens this process, and a cell is produced within the globule much resembling the coloured cell in the blood, only smaller, and the outline is irregular. If the acid be diluted to exactly the proper strength (determined by experiment) a cell will appear within the white globule, exactly resembling the coloured cell in the blood, except that it is paler and smaller.

56. There is no difficulty in demonstrating the above, provided the manipulation is as I have described; if not, if the blood is first placed upon the

glass, and coagulation commences before the water is added, the result will always be a failure. The blood must be dropped fresh drawn into the water, and the acetic acid added afterwards. This experiment, although performed out of the body, is yet done upon live blood; if the blood be dead—that is to say, if coagulation has commenced—the effect is quite different. I believe that what is here performed artificially is beautifully carried on in the lungs every minute of our lives, new blood being the result. I shall speak further of this when engaged upon assimilation.

FIG. 4.

Represents the action of diluted acetic acid upon the white cell immediately on its removal from the circulation. The first shows the appearance produced by the most diluted acetic acid, many molecules appearing within the cell. The second, where the acid is a little stronger, the molecules gather towards the centre. The third, the acid is in the exact state of dilution to produce the cellæform nucleus within the cell. The remaining three show the effects of less diluted acid.

57. The water given off in the lungs, is derived from the excess which has been absorbed from the chyle during its completing stage; and also is formed there by the union of the oxygen of the atmosphere with hydrogen, from some weak hydro-carbon brought to the lungs by the blood for that purpose. Under certain conditions of the atmosphere and of the blood, it is possible that water may be absorbed by it, although not in large quantities. Nitrogen also

is given off by the blood in the lungs; it also, under some circumstances, may be absorbed.

58. The colouring matter of the blood is in solution in young cells; but in old cells, namely, such as are broken up in the liver, the cell-walls will be found coloured, the hæmatin having combined with the structure of the wall. This can be demonstrated in broken down frogs' liver under the microscope, where the coloured envelopes may be seen floating about, the nuclei and contents having escaped. Hæmaphæin found in the cell and in the serum is of a pale straw or amber colour, is soluble in water, and passes off in the urine; it does not appear that hæmaphæin is dependent upon iron at all for its colour, and it turns very dark upon keeping, as is seen in some forms of urine when kept. Hæmatin is of far greater importance: it is of a nitrogenous character, and important diseases are connected with its abnormal formation and excretion. It is possible that hæmaphæin may be but a modification of hæmatin; at all events, they are found in separate situations, both in the blood and in the secretions.

59. The colour of the corpuscles of the blood is effected by two forces, chemical and mechanical: they are reddened by contact with oxygen, also by a strong solution of salt. On the contrary, they become darker by contact with carbonic acid, and distilled water. When they are contracted biconcave, they, in masses, reflect a crimson colour; when swelled biconvex, a purple. Although the colouring matter is the same in both cases, yet I believe that they are in

a different state of oxygenation, and that the difference is not entirely owing to their change of form. Water dissolves the colouring matter of the blood in all proportions; but the serum of the blood will not take up beyond a certain quantity—Berzelius believes, on account of the albumen; Müller, from the salts in solution.

60. The blood-cells contain within them an acid salt of potash, probably an acetate; the serum, an alkaline salt of soda, probably a phosphate, together with the chloride of sodium. The salts in the serum are so exactly balanced with the water as to keep the blood-cells in a normally filled condition; for if the salts in the serum were in too great an excess, the fluid contents of the cell would exude by exosmosis, whereas if the serum was too watery, the cells would fill up and perhaps burst by endosmosis; it is therefore of the greatest importance to the economy that the salts be in sufficient quantity; the urine removes any excess from the blood.

61. It is from the cells and plasma that the nourishment of the tissues is procured; from them are formed the secretions, and, except some portion of the fæces, the excretions; by their aid oxidation takes place through the whole body to its remotest atom, and it is to them therefore that our studies must be now referred, as from them the most useful knowledge of the physiology of the system is to be gained.

62. The arterial blood poured out from the heart through the aorta consists, microscopically, of immense numbers of coloured corpuscles, both old

and young, with colourless cells, not yet changed to coloured corpuscles, floating in a serum, which, after food, frequently is found to contain small masses of a proteine and fatty nature, arising either from improperly digested aliment—or, what is still more likely—immature nuclei and nucleoli from the chyle, not yet entered the stage of chyle-cell. The serum is of a pale straw colour, from hæmaphæin in solution. It is positively electric. Aortic arterial blood contains, in well-fed animals, more solid residue than venous; oxygen is found in the serum, and the salts are chiefly in an oxidized condition. Urea and uric acid have been detected in most minute quantities: these are nitrogenized matters which have been oxidized in the circulation, and which are eliminated by the kidneys.

63. Arterial blood has a greater capacity for heat than venous blood, or water; thus, if water be placed at 1000, venous blood will be 892, and arterial blood 1030, or upwards of one-seventh part more. The temperature of aortic blood is, according to Bernard, 101°.66, that of the hepatic vein being 103°.64; and although the blood has apparently become cooler in passing through the lungs, yet it has the power of giving off the seventh of its heat, and still retaining the same temperature to the thermometer: this power depends upon the oxygen contained both in the corpuscles and in the serum, and is a wonderful provision of nature to retain a uniform temperature throughout the body, from the extremities to the more central organs.

64. From recent experiments instituted by Mr. Savory, he endeavours to prove, and, I think, with success, that arterial blood in health, and under the normal conditions of aeration, is warmer than the venous; but during interruption of oxygenation it falls a degree or so below it: still there is only a degree or two difference between the two. It is from arterial blood that the secretions are derived, as the effete matters returned by the venous system require oxidation before they are fit for elimination by the various secerning organs. I shall speak further of this under the head of assimilation.

65. In the circulation, albumen is brought by the arterial blood for the nourishment of those tissues for which it is adapted. Albumen must be looked upon in two lights,—first, the mechanical, consisting of atoms suspended in water; secondly, the chemical, where these are found to consist of certain gases and inorganic constituents. Mechanically, the atoms throwing off particles of the gases of which it is the aggregation enter into fresh arrangements with the atoms of the tissues which it is about to nourish. Those atoms of gases which have been thrown off enter into fresh arrangements amongst themselves, and a complementary product is the result.

66. During all these changes, as I have before attempted to show, currents of cell electricity, or cell force, are generated; these correlate into animal heat, or nerve force, or are retained as an expansive force (a force which lies dormant between the particles of matter separating them from one another). This is

the mechanical view of the transformations of albumen taking place during assimilation; but then there is the chemical, which is only another term for the same change. The complementary decompositions of albumen are many, and take place in different situations of the capillary circulation, according to the tissues to be nourished and the ingredients required.

67. I extract the following from Simon's Chemistry:—

"The extremely high atomic numbers of many of these substances, as, for instance, of the protein-compounds, render it very probable that each atom is decomposed into various new atoms of less atomic weight. With the scanty materials in our possession we may attempt an ideal sketch of the metamorphic action that goes on in the blood, the conditions being, that there is an absorption of oxygen, and that carbon is given off; it will, at any rate, afford an illustration of the facility with which such equations may be deduced, and of the slight degree of confidence that should be placed in their interpretation, unless tested by established facts. We may, for instance, suppose that four equivalents of the organic portion of hæmatin ($C_{44}H_{22}N_3O_6$), by the absorption of oxygen, will be decomposed into choleic acid, uric acid, urea, and carbonic acid. Thus—

$$\left.\begin{array}{lll} \text{4 at. hæmatin} & . & . \; C_{176}\, H_{88}\, N_{12}\, O_{24} \\ \text{164 at. oxygen} & . & . \ldots \ldots \ldots \; O_{164} \end{array}\right\} = C_{176}\, H_{88}\, N_{12}\, O_{188}$$

"Likewise—

$$\left.\begin{array}{lllll} \text{2 at. choleic acid} & C_{84} & H_{72} & N_{2} & O_{24} \\ \text{1 at. uric acid} & C_{10} & H_{4} & N_{4} & O_{6} \\ \text{3 at. urea} & C_{6} & H_{12} & N_{6} & O_{6} \\ \text{76 at. carbonic acid} & C_{76} & \ldots & \ldots & O_{152} \end{array}\right\} = C_{176}\,H_{88}\,N_{12}\,O_{188}$$

"We may in a similar manner conceive that glutin, urea, and lactic acid are formed from proteine by the absorption of oxygen and the liberation of carbonic acid; for—

$$\left.\begin{array}{lllll} \text{2 at. protein} & C_{80} & H_{62} & N_{10} & O_{24} \\ \text{46 at. oxygen} & \ldots & \ldots & \ldots & O_{46} \end{array}\right\} = C_{80}\,H_{62}\,N_{10}\,O_{70}$$

"Likewise—

$$\left.\begin{array}{lllll} \text{2 at. glutin} & C_{26} & H_{20} & N_{4} & O_{10} \\ \text{3 at. urea} & C_{6} & H_{12} & N_{6} & O_{6} \\ \text{6 at. lactic acid} & C_{36} & H_{30} & \ldots & O_{30} \\ \text{12 at. carbonic acid} & C_{12} & \ldots & \ldots & O_{24} \end{array}\right\} = C_{80}\,H_{62}\,N_{10}\,O_{70}$$

"If we conceive that the blood corpuscles are formed of globulin (a protein-compound), hæmatin, and margarin, they may, by the absorption of oxygen and the development of carbonic acid, be decomposed into many other substances, as, for instance, into protein, cholesterin, margaric acid, urea, uric acid, and lactic acid; for—

$$\left.\begin{array}{lllll} \text{10 at. protein} & C_{400} & H_{310} & N_{50} & O_{120} \\ \text{1 at. hæmatin} & C_{44} & H_{22} & N_{3} & O_{6} \\ \text{1 at. margarin} & C_{76} & H_{75} & \ldots & O_{12} \\ \text{138 at. oxygen} & \ldots & \ldots & \ldots & O_{138} \end{array}\right\} = C_{520}\,H_{407}\,N_{53}\,O_{276}$$

"Likewise—

$$\left.\begin{array}{lllll} \text{5 at. protein} & C_{200} & H_{155} & N_{25} & O_{60} \\ \text{2 at. cholesterin} & C_{74} & H_{64} & \ldots & O_{2} \\ \text{2 at. margaric acid} & C_{70} & H_{69} & \ldots & O_{8} \\ \text{10 at. urea} & C_{20} & H_{40} & N_{20} & O_{20} \\ \text{2 at. uric acid} & C_{20} & H_{8} & N_{8} & O_{12} \\ \text{14 at. lactic acid} & C_{84} & H_{70} & \ldots & O_{70} \\ \text{52 at. carbonic acid} & C_{52} & \ldots & \ldots & O_{104} \end{array}\right\} = C_{520}\,H_{407}\,N_{53}\,O_{276}$$

"Many similar illustrations of possible metamorphic actions might be adduced, but as they do not contribute to the advancement of chemical science, we shall omit to notice them." Quite true! But at the same time some such changes do take place in the capillary system of the organism, and although these may not be the very ones, they will give an idea of capillary chemistry,—an idea which must be fully realized before advancing in the argument.

68. The manner in which the various tissues are nourished, and the way in which the effete portions are removed, I believe has not been yet demonstrated; but, from careful and prolonged microscopical examination of the methods of repair of tissue in the web of the *living* frog, and the mesentery of the *living* mouse, I believe that I am in a position to explain, in a rough manner, those wonderful processes.

69. The tissues to be nourished are of very various kinds. We have the muscular, composed of bundles of minute striated fibrillæ, of a diameter much less than that of the blood-corpuscles; we have fibrous tissues, consisting of a network of tough fibres, with interspaces of homogeneous membrane; we have tissues formed of aggregations of cells, about the size of the blood-disk. Again, there are tissues formed of very large cells, ten times as large as the blood-cell, or even larger. In the human body, at the present state of our instruments, it is impossible to demonstrate the method of repair of tissue; but with the lower animals it is different: with the tail of the tadpole, or fish, the web of the frog's foot, or the

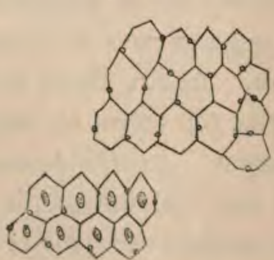
mesentery of mice, rabbits, &c., the secrets of Nature can, with study, be wrenched from her, and be employed for our use.

70. There are few situations where we are enabled to observe, by the aid of the higher powers of the microscope, the changes which the blood-corpuscles undergo in the capillaries *during life*. Those that I have myself studied are the web of the frog's foot, the tail of the fish and tadpole, and the mesentery of the mouse, puppy, &c. I have in vain attempted to obtain any reliable information from observations made upon the web of the wing of the bat, the tissue not being transparent enough to transmit sufficient light.

71. The following remarks comprise the results of four months' microscopical observations upon the web of the frog's foot:—

Upon gradually focussing a good quarter object-glass, minute nipple-like processes, slightly raised above the surface of the epithelium, first present themselves to the view; they are situated at the

Fig. 5.



The epithelium of the web (frog's foot), showing the minute nipple-like openings. The nuclei in the lower figure appear after death, or by the agency of acetic acid.

margins of the hexagonal epithelium scales, one or two to each, and are the mouths of minute tubes which pass between the scales. The epithelium is tesselated, hexagonal, and perfectly transparent; that is to say, that during life, and except under the stimulus of reagents, the epithelium cells *contain no nucleus*.

72. Beneath this external layer lie the proper tissue-cells of the web; they are packed closely together, are oval, and not flattened. The serum penetrating between them retains their plump form; they have a granular appearance, and are not transparent. Bored between these cells are the capillaries, their coats being the cells themselves, which, by the constant attrition of the circulating corpuscles, are perfectly smooth.

73. Entering at the side of the web, and running side by side, are the principal artery and nerve supplying it. Of the same diameter as the artery, the nerve is formed by the interlacement of numerous dark bordered tubules. The coats of the artery are

FIG. 6.

The minute artery and nerve of the web of the frog's foot.—No. 1. The artery: the coloured cells flowing through the centre of the tube, the colourless globules dragging along the walls: the elongated cells forming the coats are shown. 2. The nerve, formed of dark bordered tubules. 3. The capillaries, branching off from the artery. 4. The cells, forming the tissue of the web.

formed of two or three layers of elongated flattened-out cells, overlapping one another like tiles: upon division there is only one layer of flattened cells, and in the capillaries none.

74. The flow of blood is so rapid in the artery, that the coloured corpuscles cannot be distinguished as they pass through the centre of the vessel; but, dragging and bounding along the sides with the serum, the pale globules may be seen, impelled onward by the force of the circulation. The blood is of a rusty yellow colour, but red where many cells are collected together. If the frog be made to struggle violently, arterial circulation is arrested, the veins on the opposite side of the web become clogged, and the blood in the capillaries flows backwards from the vein to the artery. Upon arterial circulation being reinstated, there is a see-saw motion in the capillaries, the blood flowing backwards from the vein meeting that from the artery; however, after several oscillations, the natural circulation is again restored.

75. On more closely examining the arrangement of the capillaries, one bent at right angles to another may frequently be observed; probably at the fork there is a mass of pigment matter.

FIG. 7.

A capillary dividing into two. At the fork three pigment-cells are shown, with a coloured cell bent upon them, doubtful by which capillary to proceed. 3. Capillaries. 4. Tissue-cells.

This is a very favourable position for observing the passage of the cells, for on arriving at the branch they frequently hesitate, as it were, which capillary to take, and a coloured cell may occasionally be seen to bend itself upon the elbow of tissue, half in one capillary and half in the other, when, after resting a moment, it will advance onwards. The capillaries are not all or always of the same calibre. The tissue-cells are very elastic, and expand or contract at the stimulus of heat, cold, chemical reagents, or from that of the nerves. A capillary, if watched for some time—half an hour or more—may be seen to expand or contract very slightly according to circumstances.

76. There are two forms of corpuscle in the blood of the frog, the coloured and the white; the coloured in the circulation is an oval flattened, perfectly transparent cell, extremely elastic, and able to take any form required by the tube through which it is passing, and the obstructions in it. The white is globular, apparently granular, elastic, but always retaining its shape,—of different diameters, some being twice as large as others: they always drag along the walls of the vessel through which they are passing, the coloured cells wriggling past them. Occasionally several white cells congregate together, obstructing the circulation; the coloured cells, however, insert themselves between them, taking any form, so as to pass on.

77. The tendency of the coloured cell is to proceed as rapidly as possible, that of the white to drag and congregate together, obstructing the capillary circu-

lation. In counting the proportion of white globules to coloured cells as they pass through a capillary of small diameter, there is no regularity; for instance, 29 coloured, 1 white, 12·1, 21·1, 40·1, and so on.

Occasionally a capillary may be seen of smaller diameter than the average, in which several white globules are collected; upon watching for a considerable time, it may become completely clogged with them, and a few coloured cells may be impacted amongst them, unable to escape either way, and circulation in that branch is arrested. If the eye be removed from the microscope, on looking again, the observer will be surprised to find that he has lost sight of the capillary altogether, that the tissue-cells adjoining the capillary and the white globules filling it, are so much alike that he cannot detect the difference; at length the few entrapped coloured cells are discovered, pointing out the position of the tube. After some time—from one to two hours—if this capillary be watched, vibration amongst the white cells may be observed; the diameter of the tube increases slightly, the force of the circulation in the adjoining vessels is communicated to the one under observation, and the white globules are slowly pressed onwards, and are driven into the circulation by the advancing coloured cells—the coloured cells, however, that had been retained amongst the white globules, are completely changed; each one has collected within itself a nucleus, the colouring matter has flown out, and they not only exactly resemble the adjoining tissue-cells, but actually are tissue-cells.

78. Upon the return of circulation in the capillary, the beating of the cells gradually flattens them out, and they form part of the smooth wall of the capillary; to make up for this fresh acquisition to the wall, some of the old tissue-cells of the opposite side are loosened, and are floated off into the circulation, and are observed to exactly resemble the white globule of the blood.

FIG. 8.

FIG. 9.

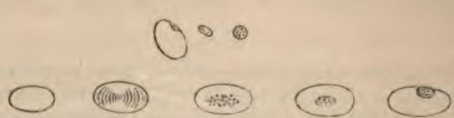
FIG. 8.—The capillaries are blocked with white globules, a few coloured cells being detained amongst them. The difference between the white globules in the circulation, and the cells forming the tissue, can hardly be detected.

FIG. 9.—The same capillaries, circulation having commenced in them, and free from the white globules. The ragged edge of the lower portion of the transverse capillary will show that the tissue-cells and the white globules are exactly alike. 3. Capillaries. 4. Tissue-cells.

79. On three distinct occasions, in four months' almost exclusive microscopic observations of the circulation in transparent portions of living animals, I have observed the above phenomena in the web of the frog's foot. I am perfectly convinced in my own mind that what I have described is the mode of repair of tissue in the web; and from other observations upon living and dead blood in the frog, I draw the following conclusions:—

80. In the circulation the coloured blood-cell contains *no nucleus*. Out of the circulation, or during such changes as I have described, a nucleus is formed. The mode of accomplishing this I have seen take place beautifully under the microscope, in the blood of a newt that had been dead two days (summer); the cell, when placed upon the slide, is transparent; the contents then appear to pucker from the circumference to the centre, and gradually draw together slowly, till at last a solid nucleus is formed in the centre of the cell, the whole process proceeding under my eye, and taking thirty or forty seconds to complete: with the aid of acetic acid it is accomplished in a moment.

FIG. 10.



The coloured cell forming a nucleus within itself, from the blood of a newt which had been dead two days. The transparent cell, the apparent puckering of the contents from the circumference to the centre, the appearance of molecules, the formation of the nucleus, the falling to the side, its discharge, and plumping up, is here shown.

81. In a drop of blood from the live frog, however quickly it may be placed on the slide and focussed, it is hardly possible to see the nucleus forming, so rapidly does it take place. This may be accomplished, however, in the living frog, by wounding the web whilst under the microscope; the cells as they escape from the wounded capillary are seen to contain no nuclei, and whilst resting on the living tissue take some minutes to form them; the cells

then shrivel, the coloured contents being poured out. I have never in the circulating blood seen a coloured cell with a contained nucleus, and I have not as yet discovered the change of the white globule into the coloured cell, although I have no doubt that it takes place, probably in the lungs. Mr. Gulliver, however, in the appendix to Gerber's *Anatomy*, has figured such a change. "Blood-disks of a very young water-newt, apparently in progress of formation from the colourless globules."

82. The white globule in the chyle found after passing through the glands, when in the granular stage, very much resembles the white globule in the frog's blood. In the chyle, the globules by the contained molecules becoming dissolved, on entering the circulation are perfectly clear and transparent. It is probable, therefore, that the white globule in the frog's blood, on entering the lungs, undergoes the same vital change; and swells up, absorbing within itself the hæmatin brought from the liver for that purpose.

83. The colouring matter of the blood contains iron intimately combined with it, and acting as a powerful stimulus to this change; by its aid the coloured corpuscle in the flowing blood has its peculiar power of volition, if I may make use of such a term; for there is no doubt that certain tissues attract certain blood-corpuscles, and that they flow towards them, avoiding other tissues: this can be demonstrated by the microscope; for corpuscles may be seen to fly towards a spot in spite of all obstacles;

and again other cells, which may be blocked up in a capillary by white globules, gradually wriggle out of it, even against the current of the circulation.

84. The white globule, on the contrary, has no attraction for any *particular* tissue; it drags along the walls of the capillaries and small vessels, impelled onwards by the *vis a tergo* of the circulation, and at every opportunity remains stationary; they are of various sizes, some only half the diameter of others, and it is probable that whilst dragging along the coats of the vessels, they may be collecting used and exhausted molecular matter for further change, or to serve as materials for secretion: this is borne out by the fact that the vessels of the kidneys of the frog contain a larger per-centage of white globules than those of other parts.

85. In the repair of the tissue forming the web of the frog's foot, it may be perceived that the coloured cell is placed bodily in position; it then gradually collects within itself its plastic contents, the colouring matter is poured out, and it becomes a single brick of the repaired structure; but in other tissues, nerves, muscles, &c., it is quite evident that this method of repair cannot be the one made use of. I have, therefore, instituted several microscopical observations and experiments upon the mesenteries of warm-blooded animals during life. I give the animal chloroform, and whilst under its influence, the mesentery is placed beneath a quarter object-glass as soon as possible: the animal seldom survives the operation more than twenty minutes: it is, therefore, a very difficult

matter to make accurate observations; but on one occasion I observed in the mesentery of the live mouse the following method of repair:—

86. *One-inch Object-glass.*—The mesentery is sparingly supplied with blood-vessels,—two or three large ones are seen with nerves to pass to and from the bowel.

Quarter-inch.—The blood-vessels are covered and surrounded by innumerable fat-globules, from the most minute to some having the diameter of 1-500th of an inch. The mesentery is composed of a network of fibrous tissue, with transparent interspaces; an artery, dividing into a larger and smaller branch, runs towards the bowel; at the bifurcation an eddy is seen (during the rest between each impulse of the left ventricle) to contain many cells floating in the serum. Some blood-cells escaping from a wounded vessel upon the surface of the mesentery, immediately swell up, probably from endosmosis of the thin serum bathing the mesentery. At right angles to a capillary, a portion of the tissue appeared blocked with blood-cells in various degrees of liquefaction: in one portion the outlines of the cells were so pale as hardly to be detected, and the colouring matter almost removed. At another part the cells were more distinct, and surrounded by molecules of coagulating fibrine taking a fibrous arrangement. Dilute acetic acid being dropped upon the mesentery, the hitherto transparent interfibrous portion has a cellular appearance, nuclei, and larger and smaller cells are seen, in the same manner that, upon the addition of

acetic acid to the frog's web, a nucleus gathers within each epithelial scale. From what I observed generally, I drew the following conclusions.

87. The mesentery is composed of a moderately fine network of fibrous tissue, between the meshes of which pass blood-vessels to and from the bowel; the nerves are, as they always are, well supplied with blood; the lacteal runs with the vessels, laying up without its walls a large supply of fat for use when required. The tissue is repaired as follows,—a capillary is blocked with blood-cells, the pale globules break up, discharging their contents as minute fibrillæ; the fibrine of the plasma gathering up, its molecules form a network of fibres joining those in the neighbouring tissue; the coloured cells melt down in the interspaces, forming an interfibrous membrane, which, in the live animal, is perfectly homogeneous and transparent, but after death, and upon the stimulus of acetic acid, is seen to take a cellular and nuclear arrangement.

FIG. 11.

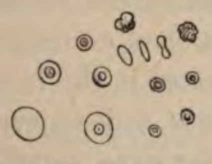
The mesentery of the mouse.—On the right-hand side of the figure the fibres of the tissue are shown with the transparent interspaces. On the left-hand, at the lower portion, a blocked capillary; at the upper, large cells and nuclei appear, the result of the action of acetic acid.

88. The capillaries running as they do in the areolar tissue (as it is correctly called in man, although cellular

in reptiles, &c.), afford nourishment to the other tissues; that is to say, the areolar tissue acts as a sponge, absorbing the materials from the blood which is constantly flowing in its substance, to supply the more delicate tissues with materials for their repair, blood-cells actually melting down into a solution of molecules for such purposes. The areolar tissue is found everywhere where blood-vessels are required, except in some of the glands, the capillaries there running between the cells themselves. During life, areolar tissue is transparent and apparently homogeneous, but after death, or by the aid of chemical reagents, nuclei and cells are produced, showing the original materials of which it is composed. Running with and around this homogeneous tissue, are many fibres, and fibrillæ of elastic tissue.

89. We thus perceive that the blood-corpuscles themselves, being retarded in the capillaries, arrested by the larger white cells, melt down, and are made use of by the tissue for which they are required; at the same time the waste particles that are floated off enter the circulation and become oxidized as they

FIG. 12.



The white and coloured cells of the blood in man, observed under different aspects, and with different magnifying powers. The two upper globules are coloured cells undergoing coagulation, collecting within themselves the most delicately fine molecular matter, as seen by the aid of a powerful sixteenth (by Powell). A quarter will not detect these fine molecules.

proceed, eventually to be discharged by the organ whose structure is peculiarly adapted for their elimination.

90. In the skin and mucous membranes, where the cells composing them are so much larger than those of the blood, the layer nearest the capillary is formed of blood-corpuscles; they increase in size as they proceed outwards by absorbing fluids of the plasma, and grow until removed from its influence, when, having attained their full size, they are thrown off as effete. The epithelium scales when thrown off are dead; the fibrine, as the last act of life, coagulates in the centre, forming the so-called nucleus. It is easily demonstrable in the foot of the frog or the tail of the fish, that the hexagonal epithelium scale contains no nucleus during life, except under the stimulus of chemical agents. There are doubtless many tissues that are nourished solely by the plasma —the cartilages, for instance, containing soda derived from it; but the higher order of tissues, the muscles, nerves, &c., gain their nourishment from the cells themselves.

91. The waste particles of the tissues combine with the oxygen brought by the blood, and entering into new arrangements, are carried off by the veins, again to be oxygenated in the lungs, part passing off as carbonic acid gas and watery vapour, part becoming materials for some secretion, and part undergoing some further change.

92. The coloured cells melt down, yielding their plastic contents for the nourishment of the tissue

requiring repair; the white globules take up, or are formed from the waste matter of these tissues, and within themselves prepare their contents for some secretion for which they are adapted. In the circulation, or even out of it, I have not yet been able to demonstrate by the microscope the difference between the perfect chyle, or lymph-cell, and the white globule of the blood, they bear so great a resemblance to one another. I have no doubt that it may be done eventually.

93. By these observations, I have endeavoured to show that the repair of the more complex tissues is a work of time, that the cells by which the plastic matter is elaborated, pass through many phases and visit many organs, imparting and receiving fluids, by which the changes required for their ultimate consummation, and ability to form a part of the solids of the body, are effected. Whilst undergoing this process secretion takes place, the glands—aggregations of cells—remove crude ingredients from the new blood, and produce a change in them, adapting them to the wants of perfectly normal blood. Excretion is the act of removing from the blood old and waste matter, principally derived from the worn-out tissues, which have been repaired by the perfect blood.

THE LYMPH.

94. Pervading every part of the body, are a series of vessels called lymphatics, or absorbents; their function is to absorb from the tissues which they pervade

those molecules of fibrine, albumen, salts, &c., which have been separated during tissue change, and which are imbued with sufficient vitality to form the nucleoli and nuclei of lymph-cells. The lymphatics are to the tissues what the lacteals are to the chyme,—they absorb all that they are able, and proceed in exactly the same manner; nuclei appear in the lymph as it flows, and cells are formed, eventually to be converted into blood-corpuscles. It is very probable that the lymphatics communicate with the veins during their course, as Hewson has pointed out.

95. "The lymph is a thick viscid liquid, of a yellowish or greyish-yellow colour; owing to the contained fibrine it coagulates almost immediately; it contains globules of yellowish tinge smaller than the blood cells." (Becquerel and Rodier.) The fibrine in lymph, unlike that in the chyle, firmly coagulates, being derived from the tissues; those portions of fibrine which, in secondary assimilation, are separated from the tissues with the waste substances removed by the veins, are absorbed by the lymphatics, and, together with albumen and serum, form the lymph. The nuclei of lymph-cells—the globules of a yellowish tinge of Messrs. Becquerel and Rodier—after passing through the glands, eventually become converted into lymph-cells, and undergo the same change as the chyle-cells in the lungs.

THE NERVOUS SYSTEM.

96. Although the lowest classes of the animal kingdom may be endowed with sensation and motion, they have no nervous system—that is to say, there is no system of nerves, no tubules or fibres connecting one portion of the animal with another; and yet there is evidently sensation, and consequent motion. This arrangement can only be accounted for by considering that sensitive corpuscles are distributed in the tissues, and that the tissues themselves conduct the intelligence from one nerve-corpuscle to another. In the fœtus of the higher animals, before a nervous system is formed, the peripheral nerves are produced by stellate cells, which lengthen and join together, forming a continuous nerve-tubule; but there is a time in which they are perfectly independent of the great centres, and yet all the various and complicated processes of increase and nutrition proceed perfectly, without the aid of any nervous centre, beyond the sensitive corpuscle in the immediate neighbourhood.

97. To account for this, an inherent and separate vitality in the part itself must be allowed. This is proved in many of the lower classes of animals, which may be separated into various portions, and yet each part will continue to live, and even set up an independent existence of its own. In the turtle, although a cold-blooded animal, yet of a very complicated structure, the heart may be removed and cut into a hundred pieces, each portion keeping up a rhythmical contraction and dilatation, as if it were still a con-

stituent of the living body of the animal; proving that the vitality—the nervous power of each piece of the heart—is inherent within itself, and although connected intimately with the rest of the animal, still is perfectly independent of it. And if it were possible to nourish that extracted portion of heart, there is no reason why it might not contract and dilate for an indefinite period.

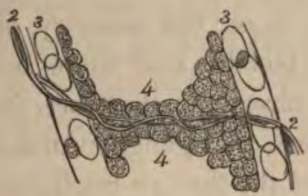
98. In warm-blooded animals, where the perceptions are so much more acute, the intimate connexion between the separate great centres and the peripheral system of corpuscles, must be more direct and more complicated, and one portion of the system cannot be affected, but what others sympathize; there is, therefore, a greater dependence one upon another; this is proved in the instance of any great shock to the system from an accident or otherwise, that, although no vital part may be injured, yet from sympathy, the centres may be so paralysed, that death ensues.

99. The connexion between all portions of the system in man is so exceedingly intimate, that no peripheral injury, however slight, but would be appreciated by all the centres instantaneously; and it is this delicacy of the nervous system that places us at the head of created beings, and yet makes us so much more liable to suffer from external influences.

100. Passing by the side of every artery down to the most minute, only to be discovered by the microscope, is a bundle of nerve-fibres; the fibres decrease in number by degrees until we find two nerve-

tubules running along the side of a capillary, probably at length crossing it, and finally lost in the tissue.

FIG. 13.



Two nerve-tubules passing from one capillary to another, crossing the intercapillary tissue. 2. The nerve-tubules. 3. Capillary. 4. Tissue-cells in the frog's web.

101. Frequently, upon these small bundles of nerve-fibres a mass of nerve-cells may be seen: these masses of nerve-cells are called ganglia; they may be seen at the branches of all arteries that supply any portion of tissue.* From these collections of nerve-cells bundles of nerve-fibres are given off in various directions, always accompanying the vessels, eventually to be spread upon the intercapillary tissue; these nervous fibrillæ, or tubules, collect the fluid (electrical, or by whatever name it may be called) given off during tissue-change.

102. I have before shown that no molecular change of any sort can take place without giving off currents of this fluid. The nerve force or intelligence is referred or carried to the nearest ganglion, where it is inten-

* Upon examination, microscopically, of the branches of the sympathetic, the presence of small secondary ganglia are discovered. These may be seen in the branches of the hypogastric plexus, which enter the posterior part of the corpora cavernosa penis, and the prostate—and, in fact, on all the branches. (Remak, Schwann, Retzius, Müller.)

sified and reflected in another direction; thus, if the tissue from whence the intelligence arrives requires more blood, the fluid is passed on to the branch of the artery supplying the part, and more blood is poured into it; if, on the contrary, the part is well-nourished, less blood is sent there, but it is directed in a different direction; therefore, in a healthy condition of the part, that ganglion undertakes its whole supervision, and the fluid or intelligence is not passed on to any ganglion beyond, but is reflected to the portion of tissue under its immediate direction.

103. The fluid acts instantaneously; therefore fluid collected at one portion of a capillary may be referred to and from a centre to the next capillary, before the circulation has advanced so far, so that any repair required by the tissue, or any effete matter to be removed, is already understood by the blood-cells, which immediately proceed to effect the desired change. These centres have the property of producing contraction and dilatation in the arteries, and to a certain extent upon the capillaries themselves, by filling or emptying the tissue-cells forming their walls, with serum.

104. If the peripheral fluid be normal, the nervous fluid will be the same; but if not, then the ganglia have a resisting power, until they themselves, by malnutrition, yield and transmit abnormal fluid; if therefore a slight local disease occurs, it may not be transmitted, but may be cured locally; but if the general system is weak, the abnormal fluid transmitted to the centre is referred, and so complications innumerable arise.

105. In an earlier portion of this work I have endeavoured to show, how the various currents (collected during molecular vibration by the peripheral system of the sympathetic) are transmitted in intermittent currents to the ganglia; these ganglia serve to collect the fluid, intensify it by induction, and discharge it, in a concentrated form, in any direction required.

106. It is, I believe, now generally acknowledged, that certain portions of the muscular system are chiefly under the control of the sympathetic system of nerves —the heart and uterus, for example. All muscular organs or tissues controlled by the sympathetic have a rhythmic action: the ganglia collect the fluid, hold it for a time, and then discharge it, and so on. This rhythmic action depends upon a slowness of conducting power, which is peculiar to the sympathetic. The nerves, both of the cord and of the brain, are rapid conductors: those of the sympathetic, on account of the numerous insulators—the ganglia—are, on the contrary, slow.

107. It is probable that the nerves of sensation and motion are continuous from periphery to ganglion without a single break, whereas the sympathetic system proper, are composed of very short tubules, soon ending in a ganglion-corpuscle; this, which histology proves, bears out the view I have hazarded. The nerves, as well as conductors, are inductors; in fact, except that the nerve-tubules are continuous from periphery to ganglion, the muscular tissue is a better conductor than the nervous; for if electricity be applied

to the two at the same time, the fluid will prefer passing by the muscle to the nerve.

108. In the experiment made by Bernard, in which he divides the sympathetic in the neck, that side of the head inflames; in other words, a large supply of blood is sent to the part, the ear and eye become red, are hotter than on the opposite side, and if the animal experimented on be a weak one, suppuration of the conjunctiva may supervene.

109. What has taken place? The sympathetic system above the portion severed is nearly cut off from the centre (we know that it is not entirely cut off, because after a time the animal gets perfectly well, the circulation of nervous fluid finding some other channel to the centre); during this time the part itself has its vitality *nearly* under its own control; it is not affected by what is going on elsewhere; it does not *know* that the stomach, the spleen, or the liver, may want a larger supply of blood, therefore it takes all it can get for its own nutrition; more blood is attracted to the part, tissue-change goes on rapidly, even stasis may take place, and suppuration be the result, the blood not knowing that it is required elsewhere, from the communication with the centres being for the most part cut off.

110. If, however, the nerve be galvanized, we find a very different state of things: the blood circulates more rapidly, the capillaries, instead of attracting and retaining the blood, pass it on, and there is an opposite condition of the part; it may become even colder than on the other side. Here the centre has excess

of power over the peripheral corpuscles, and the blood is not allowed to accumulate in the part, but is sent on.

111. We arrive at this rule,—that where the centres are powerful, blood is not allowed to accumulate in the periphery, except when required. When the centres are weak, blood accumulates in the periphery, and over action occurs in that part. The centres, therefore, exert a controlling influence over the peripheral corpuscles, although they must derive that power from the fluid which they receive from those corpuscles.

112. But we see in the frog's foot, that secretion is most energetic when a large supply of blood is sent to the part, but not allowed to accumulate, but is passed on rapidly. Then in stasis secretion would not be active, and this we find to be the case. Where the blood is arrested, secretion stops, a dryness of the part follows, and eventually, if not prevented, the formation of pus or gangrene ensues. The peripheral nerve-corpuscle attracts the blood, and collects fluid to transmit to the nearest ganglion; here the fluid is intensified, and reflected to the peripheral corpuscles of the neighbouring tissue or capillary, and the excess of nerve force passes on to the next ganglion.

113. Under extraordinary circumstances, the intelligence transmitted may pass on to the great nerve centre of the sympathetic, the semilunar ganglia, or to the cord, or even to the brain. Reil "has compared the ganglia of the sympathetic to imperfect conductors of electricity, and imagined that they do not

communicate to the brain feeble impressions, but, just as imperfect conductors, permit large quantities of accumulated electric fluid to pass, they are able to propagate very strong impressions, and also permit a limited influence of the brain and spinal cord upon the sympathetic nerve."

114. The ganglia of the sympathetic have the power of transmitting an intelligence under peculiar or abnormal circumstances, which usually they are unaccustomed to do. Thus a ganglion, which ordinarily merely supervises the nutrition of a part, watches over secretion, and transmits the fluid collected during these processes,—in case of injury, may transmit intelligence to the cord, or brain, expressive of pain or uneasiness, producing a reflex action from the cord, transmitted either to itself or to some adjoining muscle. The following experiments will bear out this view:—"Brachet divided the costal cartilages, and held the lung towards the sternum. He then pricked the thoracic ganglia of the sympathetic, or the cord of the sympathetic between them, but the animal evinced no signs of pain; but when he irritated one of the branches of communication between the sympathetic and the spinal nerves, pain was distinctly manifested. He also observed that ganglia, which at first appeared devoid of sensibility, became sensible after frequent irritation."

115. In inflammation of a part supplied by the sympathetic, which during health and under ordinary circumstances conveys no intelligence to the brain, the pain is frequently most intense, even more so than in

the skin, which is so liberally supplied with sentient nerves. Thus, in peritonitis, the pain is most agonizing, and yet, under ordinary circumstances, the peritoneum appears to be non-sentient; the reason is, that the ganglia of the sympathetic have no ability themselves to acknowledge the intelligence of pain transmitted to them, they therefore transmit such to the brain. Under ordinary circumstances, although the constant movements of the bowels must give rise to the same sensations which would be produced by the same movements taking place upon the skin, yet the ganglia take no cognizance of it, and it is not transmitted to the brain.

116. Thus a system of nerves and its ganglion may be likened to an electro-magnetic apparatus: the tissue-change gives rise to the fluid, as in the battery: this is transmitted to the ganglion, where it is intensified, as in the magnetic arrangement; but there the simile ceases, as the method of direction is peculiar to the nerve-ganglion. According to this theory it can be easily understood, that if there is any error in tissue-change it may, by transmitting an abnormal fluid, upset a remote part which hitherto had been in perfect health, but by having intelligence conveyed to it which is not true, and by acting upon it, increases the mischief, which had been commenced elsewhere. If this be not checked, the error will be transmitted to the next centre, and so on, until the whole system is upset.

117. By this method of reasoning, the sympathetic first receives the fluid, the excess is then passed on

to the other centres, the spinal cord, and brain; but in man, especially at the present day, the brain is so worked, that in the majority of men in large cities, that organ becomes the great recipient of the fluid, at the expense of the spinal cord, and even of the sympathetic system itself; consequently, to retain the health of the body, stimulants are resorted to, which by increasing the amount of molecular change, give rise to more active currents of fluid, which supply the nervous centres with their proper stimulus.

118. It may be frequently observed, that although tissue-change appears to go on actively, nervous energy does not succeed; in these instances the ganglia lose, to a certain extent, their power of induction, and the fluid is not intensified. This is a partial paralysis of the function of the ganglia, and arises generally from one of two causes: firstly, from an hereditary weakness, and, secondly, from some malarious or epidemic influence.

119. The brain and cord consist essentially of corpuscles constituting the centres, or inductive apparatus, (the fibres merely conducting the nerve force to and from them),—they intensify, direct, and supervise the distribution of the fluid brought to them. An infant is in that state of development when the sympathetic system is most active; but little nerve force is spared for the cord and brain, beyond that collected by the sensitive nerves for the use of the excito-motory system. In childhood and youth, the cord gradually draws towards itself a larger supply of nerve force,

the sympathetic and the cord sharing the fluid, the brain still receiving but little.

120. But in civilized society, as manhood steals on, the brain becomes the centre for the accumulation of the fluid, frequently to the detriment of the other centres, and the brain, by constant application and by the disuse of the functions of the cord, collects nearly all the fluid to its own use, the sympathetic by degrees yielding not only the excess of fluid absorbed by it, but almost all of it; and disease is frequently originated, by the brain withdrawing the nerve force, which should be directing and supervising nutrition and secretion.

121. When tissue-change is going on rapidly, and when the centres are over excited by such stimulus, at the same time paralysed as to their normal function,—as, for instance, in fever—the spinal centres, and even the brain, may, by receiving the excess of nerve force generated in the peripheral system of the sympathetic, be really in a higher state of tension than in health. The delirium and muscular strength of fever patients is well known. Upon returning health, where repair of tissue goes on slowly, the sympathetic seize upon all the nerve force generated, making use of it to carry out their own functions, re-establishing secretion, &c.; the brain and spinal cord receive but little, and their functions lie in abeyance until the sympathetic has established the organic normality, when the fluid flows on to the spinal cord and brain.

122. THE NERVES,

Without attempting to be too precise, may be divided into two categories—the naked and clothed: to the naked, the sympathetic system belongs; to the clothed, the majority of the cerebro-spinal. The naked are those nerves which have no external oily coat, and are not such good conductors of nerve force as the clothed: the naked do not generally run a very long course, but soon terminate in a ganglion-corpuscle: the clothed may run a very considerable distance, namely, from the sole of the foot to the cord, before terminating in a corpuscle. By the aid of reagents the nerve has been separated into three divisions—the sheath, the oily coat, and the proteine or central cord. In the sympathetic system of nerves the oily coat appears to be wanting; there is no absolute certainty, however, that this is really the truth,—it may be the result of chemical and other manipulation. In the frog's foot, where the nerves may be seen very distinctly and traced to a single fibril, they resemble a clear tube with dark borders, and the contents within the sheath are probably homogeneous until acted upon by reagents.

123. Peripheral nerves terminate with a naked extremity: this I have not been able to prove by the microscope. The naked extremity is either an exudation of the internal portion of the nerve, or a ganglion-corpuscle. It is only the peripheric termination of the nerve that is acutely sensitive, the nerve itself being but very partially so; and even

when sensitive, referring the sensation to its terminal. Also in exciting reflex actions, the slightest touch upon the skin is sufficient to excite active reflex muscular movements, whereas the nerves themselves show far less power of sensibility to the reflex function.

124. If sufficient pressure be used upon a sentient nerve, the communication between the periphery and the centre is cut off. The nerve electricity is prevented from passing to the centre, and by accumulating in the nerve gives rise to the sensation of formication, and yet that very part to which the sensation is referred, has lost its sensibility to external impressions, by being disconnected with its centre and the brain.

125. When a nerve is divided, the paralysed peripheric terminations, although insensible to external stimuli, become, during the existence of inflammation in the wound, the seat of pain. When the inflammation has subsided pain ceases, and the part is again devoid of sensation. These phenomena may be thus explained:—When inflammation is set up, the irritation in the wound gives rise to a current towards the centre; but the centre having been educated to refer such a current to its peripheric terminations, does so now, and the pain, which really is at the cut termination of the nerve, is referred to the various peripheric terminations with which it was formerly in connexion. At the subsidence of inflammation the pain ceases.

126. The small microscopic arteries, from the sub-

divisions of which the capillaries emanate, are most abundantly supplied with nerves, and at their bifurcations the minute ganglia are placed: these ganglia supervise the nutrition, &c., of the portion of tissue from which the nerves pass to and fro; the capillaries having their walls formed by the tissue through which they pass, derive their tonicity from the condition in which that may be,—this is easily demonstrable in the frog's foot, where the tissue is formed of distinct cells, and when, after starving the animal for some time, the cells are in an atonic and flaccid condition, upon stasis being induced, the blood-corpuscles force their way between the yielding cells. The tonicity of the capillaries therefore depend upon the state of nutrition of the part, and the increased or diminished supply of nerve force forwarded to the small ganglion at the bifurcation of the artery.

127. In sudden pallor, or blushing, caused by mental emotion, the intelligence originated in the cerebrum is transmitted to the sympathetic system, especially that portion ruling over circulation,—the heart ceases to beat, the arteries contract, and the surface is blanched; or the contrary takes place,—the arteries supply more blood than the veins carry off, and a flush is the result.

128. It must not be supposed that the capillaries contract; I do not believe they do, except to a very slight degree, and that not from any innate power within themselves, but secondarily, through the tonicity of the tissue. On the other hand, the minute arteries contract powerfully by means of a proper

muscular coat, and can instantly arrest the circulation at any moment upon nervous stimulus. The extraordinary influence exercised by the brain over the capillary system, can only be explained in this way. I have seen the skin covered in a very few seconds with irregular, raised, crimson patches, merely from mental emotion,—the profuse cold perspirations induced by fear, the bristling of the hair from general contraction of a part, the shiver running through the whole body, are all examples of this power.

129. The following are the results of a few experiments, made by passing galvanic currents through the web of the foot of a frog, whilst under microscopic examination. If a moderately powerful galvanic current be passed through the foot, the circulation instantly ceases, the arteries contracting arrest the circulation, the blood flows on into the veins, and for a moment the capillaries are empty, *but patent.* The capillaries have nothing to do with the arrest of circulation; the arteries contract; the capillaries remain passive. If the arteries do not soon continue the circulation, the veins return blood to the capillaries, and a circulation of venous blood ensues, until the *vis a tergo* of the arterial circulation drives on the blood into the veins.

130. If, instead of a powerful current being passed through the web, a gentle continued current is made use of, the arterial circulation is excited, a much larger supply of blood is sent to the part, secretion is profuse, and the foot is bathed in serum.

The rupture of a capillary doubtless could take

place from over action, but, as a rule, where blood escapes from a capillary it is from malnutrition, there is not a healthy supply of nerve force, cohesion of the cells is not powerful, and upon engorgement they give way.

131. The brain has a powerful influence over nutrition in this way—by excessive action the nerve force is concentrated upon that organ, removing it from others. The lowering passions—grief, despair, &c.—may in a very short period originate disease, hereditary or otherwise, by lowering the nutritive powers. The flow of saliva to the mouth upon the sight, smell, or even idea of food; the flow of milk into the breast upon seeing the babe; and many other examples, needless to repeat, of the effect of the mind upon secretion, are familiar to all. Also the buoyancy of the body, and the improved state of health, from a piece of good news or fortune, showing the influence of the mind upon nutrition; not that it ought to have such all-engrossing power normally; but, owing to the manner in which the mind (brain) is trained and stimulated, at the expense of the body, it arrogates to itself many functions to which nature never intended that it should lay claim.

132. I have already endeavoured to prove that the result of mental labour is to lessen the nutrition of the body, by withdrawing nerve force from the sympathetic system of ganglia to the great centre, the brain at the same time not compensating by any greatly increased molecular change going on within its capillaries. Now, there is another great system,

namely, the muscular, which the more it is worked (short of great fatigue) the more nerve force is transmitted to the centres; for the molecular changes caused by the destruction of tissue going on during muscular exertion, and the repair of the same, supply the sympathetic and sensitive fibres of the cord with their normal fluid.

133. The force of our voluntary movements is dependent on the motor tension of the spinal cord, and the intensity of our muscular efforts is also in a great measure dependent upon it. "The greater part of the motor nerves are, it is true, excited to action not by the spinal cord, but only by the influence of the will, and when this is not in operation they are left in a quiescent state; but, nevertheless, the force and duration of the motor actions, excited in these nerves by the sensorium commune, are determined by the spinal cord. The cord is always charged, as it were, with motor power; and although in transmitting the nervous force from the brain, it acts as a conductor of the oscillations originating in the sensorium commune, still the intensity of the action excited depends not merely on the strength of the will, but also on the amount of motor power accumulated in the cord. Hence this part of the central organs may retain its property of conducting the volition from the brain, but lose the second power by which it determines the strength of our movements; and this is what happens in tabes dorsalis, a disease caused by debauchery, and attended with atrophy of the cord. Here no muscle of the lower extremities

is at first paralysed; all obey the influence of the will; even in the advanced stages of the disease, the patient can execute every movement, and it is evident, that the spinal cord is still unimpaired as a conductor of the oscillation or current originating in the sensorium. But the force of the movements is lost; the patient can neither stand nor walk for long at a time, and the power gradually diminishes until the paralysis is complete."

134. The mode of propagation of irritation from peripheral nerves to various central ganglia, is beautifully shown in some cases of dentition in infants. Thus, with some children, the pressure of the teeth upon the mucous membrane, the increased flow of blood to the part, and the gradual separation of the gums, sets up an excitability of the nervous system which may be slight with care, but with neglect may cause death. In some instances, the irritation may be reflected to the centres of the excito-secretory system of Marshall Hall, and we may have salivation, diarrhœa, bronchial irritation, engorgement of the lung or liver, or skin affections; or, on the other hand, the irritability may be reflected to the excito-motory system, and convulsions result. The centre to which the morbid irritability is guided, depends upon many causes, such as hereditary weakness in any particular organ, some epidemic or atmospheric influence, or from some acquired predisposition; the organ secondarily affected appears to act as a safety-valve to the excitement set up in the gums.

135. Carbonic acid gas is constantly, day and

night, winter and summer, although in varying proportions according to circumstances, being excreted by the blood in the lungs; the repair of tissue surely does not require this immense waste of material. The most idle man—the fat, unwieldy inhabitant of the Eastern harem, who is afraid to move lest she should lessen her value in the eyes of her lord by losing a portion of her obesity, eats largely. Merely to throw off this waste from the lungs? Surely not; there must be a cause, and it is this.

136. The nutriment absorbed by the lacteals, converted into albumen, fibrine, and blood-cells, is conveyed into the most minute interstity of the organism by the capillaries; here the oxygen brought by the blood seizes upon some hydro-carbon with which to unite, giving rise to molecular change—to currents of electricity; these currents are collected by the nerves always accompanying the vessels, and serve to feed the nervous system; at the same time some portion correlates into animal heat, &c. It is then to feed the nervous system that this tissue-change, beyond that really required for repair, is constantly going forward, and so much carbonic acid is excreted from the lungs. It is not, then, a wilful waste, this apparent loss of carbon; on the contrary, life could not last without it—nervous energy would lessen, the extremities and skin would get cold—circulation would become sluggish, and death eventually ensue.

137. The generation by molecular change, the transmission to the ganglion, the intensifying and reflexion to the periphery, and to other centres, of

nerve force, fluid, or electricity, for the uses of the system, I have to the best of my ability endeavoured to explain; and although many errors may be discovered by my readers—I trust indulgent critics—still I venture to hope, that I have led the way to a field of research hitherto lying fallow in the vast realms of Physiology.

138. The heart is supplied with nerves in a most abundant manner; first, there is its own ganglionic system, upon which its rhythmic action depends, fibres from which intercommunicate most completely with the thoracic ganglia, the cervical ganglia, and the semilunar ganglia, the great centre of the sympathetic. The heart being in close communication with these centres, sympathizes with them all, and if the fluid or intelligence brought by them should be of such a character, as to draw off the attention of the nervous influence of its own system (if I may be allowed the metaphor) from itself, the heart's action will be irregular: it palpitates, intermits, is too quick or too slow, according to the intelligence brought and the intensity of the impression; therefore the rhythmic action of the heart may be affected, and to any amount, from sympathy with the ganglionic system.

139. But the communication between the heart and the spinal cord is also very intimate, although not equal to that between it and the sympathetic system. Lying along the ribs, on each side of the spinal column, are ganglia of the sympathetic, intimately interlacing their fibres with those of the cord; the spinal accessory nerve also is closely connected with

the nervous system of the heart; it will consequently respond to any intelligence transmitted by the spinal system of nerves. This is found practically to be the case, both in experiments made upon the cord and also in disease. Painful or pleasurable sensations of the skin increase the heart's action by reflexion from the cord; the same also is induced by muscular exertion; but it is in disease where the sympathy between the nervous system of the cord, and that of the heart, is most powerfully expressed. Every reader must be able to remember many such cases.

140. The sympathy between the brain and heart is so intimate, and so well known by all, that it is sufficient to mention it, and requires no demonstration. Anatomically, the vagus unites them by its powerful meshes, and there is not an idea which passes through the brain which does not affect the heart's action. The brain has so great an influence upon the heart, that many anatomists have considered the brain to be the centre, controlling its movements. This, however, is now acknowledged to be an error.

141. There is a case on record in which a gentleman, by the force of will, had the power to arrest the heart's action entirely for a time, and it is very probable that, by practice, such a power could be eventually acquired by many. The idea I wish to be realized is this,—that the heart contains within itself its own system of nerves, whereby it is enabled to carry on its own rhythmic action independently of the rest of the nervous system; but that it is so intimately connected with every single fibril, or even atom of

the system by the nerves, that there is not a current of nervous fluid liberated, a muscular fibre contracted, a drop of secretion eliminated, or an idea passed through the brain, that does not, in a greater or less degree, affect the motion of the heart. Although this may not be the actual belief of physiologists at the present moment, still there is such a tendency towards it, that it may almost be considered proved.

142. As the heart, so every portion of the body, however minute, in which there is a ganglion supervising a certain amount of tissue nutrition: each may be considered a separate and independent system, connected, it is true, by the nerve fibrils with the rest, but having within itself its own powers and its own individuality, affected by intelligence from other centres, and together with them forming one grand and beautiful whole.

143. The materials of our food—carbon, hydrogen, oxygen, and nitrogen, with salts—are, by digestion and assimilation, converted into blood, a fluid adapted for the nourishment of our tissues. After serving for a time as materials of the solid body, they become useless, and have to be removed and replaced. They undergo secondary arrangements. The hydro-carbons are chiefly removed by the lungs and liver; and the sulphates, phosphates, and nitrogen, by the kidneys. In all these acts oxygen is used, both in placing the materials, and more particularly in removing them; and in every combination in which oxygen enters heat is educed. Animal heat, therefore, is generated in every particle of the body where change is going on; more

so in some parts than others; but this is not felt, because the nerves remove it by correlation as nerve force, thereby retaining a universal and equable warmth, except in disease, where the balance is overthrown, and one portion is warmer than another, the nerves, through paralysis, not being able to remove the superabundant heat generated by increased blood-destruction.

144. SECRETION

Is generally a periodic act. Perhaps there is no gland in the body that is always actively secreting; but it is liable to periodical calls. Secretion is entirely under the influence of the nervous system. A gland receives the stimulus from the nerves of the part, a rush of blood is the immediate consequence, and secretion the result. The idea of food transmitted to the nerves of the salivary glands, causes a plethora in them, and a flow of saliva ensues, and that instantaneously. This peculiar periodicity, showing the influence of the nerves, is beautifully illustrated by the sexual organs of the male and female. In the testes secretion goes on slowly, semen is poured out, and stored up in the vesiculæ; when these are filled, their function ceases, or it is possible that some portion of the seminal fluid may be absorbed, making room for fresh semen; and this condition may go on for months, or even years, there being no call made upon the organs. But suppose sexual excitement to be induced, the testes actively secrete, and many

drachms of semen may be passed off daily from organs that have been in abeyance for years.

145. A better example is the female breast. Here a large gland may never be called upon during the life of the individual to secrete a drop of milk, and yet, upon the stimulus of parturition, the gland yields a large quantity, which it is enabled to do for years, until the powers of the system suffer from the constant drain; or it may be arrested at any given moment, and may never be called upon again. The nerves of the part allow a plethora of blood, and secretion is the consequence; at other times only a sufficient flow necessary for nutrition is passed through the gland.

146. This may be easily demonstrated in the foot of the frog under the microscope. The foot being firmly fixed, one wire of the electro-magnetic apparatus is placed in contact with the leg, the other at the extremity of the toe of the portion of web under examination, and a weak current passed through. The arteries of the web immediately transmit a larger supply of blood, which is forced through the capillaries with great rapidity, the consequence being that the foot is bathed in serum. This, which can be demonstrated, is exactly what takes place in a gland. The nerves of the part stimulate the arteries to an increased flow of blood, and secretion goes on actively, until the stimulus is removed to some other complementary gland.

147. Upon the ingestion of food the stimulus commences in the mouth; a flow of saliva is the result; the stomach then pours out the gastric juice; the

liver, pancreas, and mucous membrane of the duodenum follow, and so on through the whole tube. Periodicity is very much the result of habit; a man may so educate his nerves that he may feel hungry but once a day, and he may eat enough at that meal to last the twenty-four hours; another may eat twice, another three times, and so on. The same with sleep. One may sleep in the day, another at night; one four hours, another six, eight, or more; and this habit of periodicity will be difficult, when once formed, to break through.

148. One gland also prepares the blood for that which follows it, by removing certain ingredients, leaving others for the next. The liver and skin appear to act in concert, the liver and kidneys, the kidneys and skin, and so on. Also when either of these organs is paralysed for a time, the complementary organ endeavours to do its work for it. When the liver ceases to secrete bile, the skin endeavours to remove that from the blood which the liver should have done, or the kidneys may exert themselves to pass off the secretion: it is true that they only partially succeed, and very often are damaged by the attempt; still, they prevent the blood becoming so overcharged with the excretion, as to cease to nourish the body, even imperfectly, and so allow the paralysed organ time to regain its tone.

149. EXCRETION

Differs from secretion merely in being waste, and serving no further purpose, as does the latter. Thus the urine is an excretion, because it is thrown out from the body, but it is secreted by the kidneys. The bile is a secretion, although some portion of it mixes with the fæces and is excreted. The perspiration is an excretion, being first secreted in the sweat glands. Excretion is as much a periodic act as secretion, and is subject to the same laws of stimulus.

150. The lungs are not secretory organs, but they throw off or excrete large quantities of carbonic acid and watery vapour, and small quantities of ammonia, and occasionally other gases and vapours. Their mode of doing this is dependent upon the laws governing the mixture of gases, and is principally a mechanical act, and might occur even in the dead membrane if the fluids were passed through them. Secretion is purely a vital act, and could not take place after the death of the part, even supposing the blood passed in the neighbourhood of the secretory cells.

151. The lungs are the most important excretory organs of the body, as carbonic acid is the most powerful of the poisons generated in the system. If the carbonic acid is only allowed to accumulate a very few minutes, death ensues; the poison appears to act by paralysing the sympathetic system of nerves, the heart soon ceasing to beat.

152. The skin is also an excretory organ of great

importance to the economy, and throws off from its surface, water, carbonic acid, fat, acids, the acetic or lactic, and salts: the importance of this secretion, or rather excretion, cannot be over-estimated; it is upon its arrest that most of the slight disorders and many of the greater ones depend. In rheumatism the skin is evidently the organ that we have to look to for the removal of the excess of acid in the blood; even in health it gives off much free acid—in disease it may be made to excrete immense quantities. The skin is antagonistic to the lungs and kidneys: when the former is acting freely, the latter are less energetic. The skin and liver also are, to a certain extent, antagonistic, and the liver may be relieved by acting upon the skin; this, perhaps, depends more upon the fat and salts removed by the glands than the water or carbonic acid exhaled.

ON THE ELECTRICAL CONDITIONS OF THE ORGANS OF SECRETION.

153. The various secretions poured out in such vast quantities, by the glands and free membranes which compose so large a portion of the body, will be found in almost all cases to be either alkaline or acid: few are neutral, probably none, when in a perfectly normal condition. The liver is the chief seat of the alkaline secretions, the lining membrane of the stomach and intestines being the principal acid secretors. With the liver are associated the salivary glands, the pancreas, the true genital secretions, &c. With the

stomach are the lungs, the kidneys, the skin, &c. These may be considered the two great antagonistic electrical poles of the human battery, and it is in the perfect balance of these in which health consists. But besides the true animal functions, man has another most powerful central organ, the brain, the seat of reason, and the supervisor of the passions; and although the animal functions may be inclined to be perfectly healthy, the brain has the power of arresting or altering the character of the secretions entirely.

154. In a state of complete health the amount of alkaline and acid secretions coincides, and where, by atmospheric vicissitudes or electrical phenomena, some organ is partially paralysed, and its secretion arrested, the complementary gland or free surface will undertake its duty, and by redoubled labour prevent the normal balance of alkaline and acid secretion from being destroyed. It is only when the disturbing influence is of such potency, or when the nervous power is weakened, that the body succumbs, and the patient is prostrated upon a bed of sickness. It is now the duty of the medical practitioner to discover the organ or secreting surface that is paralysed, and by judicious treatment, such as soothing an overworked organ and stimulating a lazy one, to again restore the balance of health.

155. For instance, a man, during inclement weather, gets wet through, and arrests the secretion from the skin; the consequence is, according to the time of year or his constitutional tendency, an increased flow of blood to the lungs, kidneys, or intestines. The

organ chosen, by increased labour endeavours to carry on its own proper secretion, and also that peculiar to the skin; it may be able to do this until the skin has time to recover itself, but if not, a stagnation of blood takes place in the part, and a congestion or inflammation may be the result. The medical practitioner is called in to such a case. The function of the skin is temporarily arrested, and the lungs, we will suppose, are over-worked. What ought he to do? To stimulate the skin to secrete, and to soothe the irritated and congested lungs. This done, health is reinstated.

156. Much can be learnt of the treatment of disease, by a knowledge of the chemical condition of the secretions, whether normal, in excess, diminished, or secreting ingredients which show a diseased condition of the organ, &c. The kidneys are the only glands of which the secretion can be readily collected, and of which chymists have best defined the state of the excretion, both in health and disease. And if the urine be carefully studied, although it may occupy some considerable time in obtaining the required knowledge, yet, when attained, it is readily practised, and affords an amount of insight into many diseases, especially of affections of the description concerning which I am about to treat; I shall therefore offer no apology for entering rather at length into the different methods of examining the state of the urine, and the chemical ingredients constituting that fluid in health and disease.

157. THE SECRETION OF URINE

Is dependent upon two distinct parts of the kidney, the Malpighian bodies, which supply the watery portions of the urine, with probably much of the fixed salts; and the urinary tubules, which are lined with a polygonal tesselated epithelium, and surrounded by a plexus of capillaries; the epithelium absorbs from the blood urea and other effete matters which require to be removed, and having produced certain changes, discharges them as urea, uric acid, &c.

158. The Malpighian bodies, in removing water from the blood, are subject to constant fluctuations in the amount they are called upon to pour out; if the skin is actively engaged, and much perspiration is secreted, there is not so much pressure upon the Malpighian tufts, and less water is passed from the kidneys; if, on the contrary, during cold weather, or from a chill, the skin is inactive, the pressure is greater upon the Malpighian tufts, and much water is forced out. If much fluid is taken into the stomach, the kidneys take upon themselves the task of draining off the superabundance, consequently the watery portion of the urine is chiefly dependent upon the amount of fluid in the vessels, and may be looked upon as the result of mechanicalp ressure, rather than as a true secretion.

159. On the contrary, the epithelium of the urinary tubules is a true secretory organ; it selects from the blood that which the kidneys are designed to eliminate, namely, portions of ill-digested food that are

soluble and have been absorbed by the vessels in the small intestines, and the results of the disorganization of tissue rich in nitrogen, which, if retained in the blood, would prove an active poison. Eventually the secretion is poured into the bladder, where it mixes with the mucus and waste epithelium of that organ, and is passed as urine.

160. THE URINE IN HEALTH

When passed is of the mean temperature of the body, about 100°, is of an amber colour, transparent, containing a small plug of mucus from the urethra, generally of an acid reaction, although sometimes neutral or even alkaline; specific gravity 1015 to 1020, emitting whilst warm a peculiar aromatic odour.

161. The following table, drawn up by Messieurs Becquerel and Rodier, will give the average composition of 1000 parts of urine of a healthy Frenchman passed in twenty-four hours:—

Specific gravity		1017·010
	Water	971·935
Matters resulting from evaporation		28·066
	Urea	12·102
	Uric acid	0·398
Fixed salts	Sum total	6·919
	Chlorine	0·502
	Sulphuric acid	0·855
	Phosphoric acid	0·317
	Potash	0·300
	Sodium, Calcium, Magnesium	3·944

162. The quantity of urea passed in twenty-four hours being from 225 to 270 grains; and of uric acid about 7 grains; fixed salts, 150 grains; organic matter, 176 grains. Some English and German observers have placed the average amount of urea passed in twenty-four hours much higher—namely, at 500 to 800 grains per diem. From my own observations I should set down the quantity higher than M. Becquerel—namely, for an adult male 450 grains of urea per diem; but there is such a diversity in the amount passed by different individuals, and at different times, that an average to be depended upon can hardly be stated with confidence.

163. After resting a short time a cloud gathers in the upper stratum of urine, and gradually falls to the bottom, and is found, by the aid of the microscope, to consist of mucus and epithelium. Very often, in cold and changeable weather, a slight cloud of urate of ammonia may be precipitated with it.

The principal ingredients of healthy urine are—urea, uric acid combined with ammonia, urate of ammonia, phosphate of lime, phosphate of soda, sulphate of potash, chloride of sodium, magnesia, and colouring matter rich in carbon; besides these, there are other components not always present, or in very inappreciable quantities, which do not require comment—creatine, creatinine, hippuric acid, iron, &c.

164. Liebig denies that lactic acid is the acid that is free in the urine, but he does not tell us what it is; some suppose it to be an acid salt—the acid phosphate of soda—probably it may be sometimes one,

sometimes another, according to the amount and quality of the bases in the urine with which the acids unite. M.M. Cass and Henry consider that lactic acid exists in the urine as lactate of urea, and is in direct ratio to the acidity of the urine, and proportionate to the quantity of organic matter.

165. Although having an acid reaction, there may be no free, uncombined acid in the urine, the reaction being due to an acid salt. Occasionally, when the urine contains a great excess of acid, the uric acid is set free and deposited as crystals; this may not be caused by any excess of uric acid, only from the acidity of the urine. A drop of healthy urine, immediately upon being passed, slightly evaporated and placed under the microscope, will discover the amorphous deposits of urate of ammonia and phosphate of lime, with the peculiar cross-like crystals, or rather aggregations, of chloride of sodium, and a few plumose crystals of phosphate of soda.

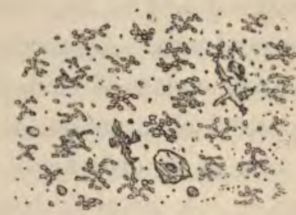
FIG. 14.

Various crystals of chloride of sodium from evaporated urine.

166. There are many deposits, of the crystalline forms of which we are not as yet aware. Thus, we do not know how the sulphates crystallize, the form

magnesia takes, and with what acid it is combined, probably as a sulphate or phosphate. In fact, upon evaporating healthy urine, it is very difficult to distinguish aught but urate of ammonia, phosphate of lime, and chloride of sodium. The remainder is so confused as to be undistinguishable.

FIG. 15.



Phosphate of lime, urate of ammonia, chloride of sodium, and epithelium scales, from healthy urine evaporating.

167. If to a little cold evaporated urine a drop of nitric acid is added, the characteristic rhomboidal scales of nitrate of urea almost immediately appear, shining and silvery, somewhat like artificial mother-of-pearl.

FIG. 16.

Crystals of nitrate of urea from urine.

168. Upon allowing healthy urine to stand, it will eventually decompose, commencing with the mucus and epithelium, and the rapidity with which it takes

place depends upon the condition of the mucus and urea—whether the former quickly commences the process, and the latter takes it up. Urine may remain acid and undecomposed for weeks under favourable circumstances.

169. The average quantity of urine passed in twenty-four hours is from thirty to forty ounces, varying greatly at different degrees of temperature and the amount of perspiration secreted. I have drawn up a table of the urine passed by myself in four days in September, weather moderately fine, not hot, drinking each day forty ounces of fluid:—

Time when passed.	Quantity.	Colour.	Reaction.	Specific gravity.	Appearance after standing.	Result after chemical and microscopical examination.
8 a.m.	℥xiv.	Amber.	Acid.	10·26	Becomes darker, throws down a cloudy deposit.	Urate of ammonia, cleared by heat.
2 p.m.	℥x.	Light amber.	Less acid.	10·20	....	Natural.
11 p.m.	℥xii.	Pale and opaque.	Neutral.	10·14	Immediately throws down a white flaky deposit, clear above.	Deposit, increased by heat, disappears upon the addition of nitric acid—phosphate of lime.
8 a.m.	℥xiii.	Amber.	Acid.	10·26	Becomes darker, throws down a cloudy deposit.	Urate of ammonia.
2 p.m.	℥xi.	Lighter.	Less acid.	10·16	Throws down a thick, pink, flaky deposit.	Urate of ammonia.
Dined out. 11 p.m.	℥xiii.	Light amber.	Acid.	10·12	Throws down little crystals in cloudy deposit.	Uric acid in urate of ammonia.
8 a.m.	℥xvi.	Light amber.	Very acid.	10.23	Crystals attached to side, and cloudy deposit.	Uric acid, and urate of ammonia.
2 p.m.	℥xii.	Lighter.	Less acid.	10·12	....	Natural.
11 p.m.	℥xiv.	Pale.	Less acid.	10·11	Flaky deposit.	Urates.
8 a.m.	℥xv.	Amber.	Acid.	10·20	Slight cloud of mucus.	Natural.
2 p.m.	℥vi.	Lighter.	Less acid.	10·22	Cloudy deposit.	Urates.
4 p.m.	℥iv.	Pale.	Acid.	10·13	Crystals in cloudy deposit.	Uric acid, in urates.
11 p.m.	℥xii.	Light amber.	Acid.	10·17	Pink flakes.	Urates.

[illegible]

[illegible] If the urine is not passed in my presence I obtain two specimens—that passed the first thing in the morning, and that passed before retiring to rest. They should be immediately placed in a bottle and corked, and not allowed to rest in the vessel any time. When I get the specimens they are well shaken and an ounce from each set aside in a phial as before described; the remainder placed in glass vessels.

172. The urine in the tall vessel is tested with litmus-paper, for its re-action, acid, faintly acid, neutral, faintly alkaline, alkaline. The specific gravity is next taken by the urinometer, and it is then set aside for a few hours.

If the urine be acid, it may be examined for excess of acidity; if it be very acid, small yellow or red crystals of URIC ACID will be seen attached to the

sides of the vessel, and caught in a thin cloud of mucus and urate of ammonia at the bottom. If the crystals cannot be observed by the naked eye, a drop taken from the bottom of the vessel may, after careful evaporation to about half the quantity, be placed under the microscope, when, if present, the crystals will appear in one of the many forms they assume.

Fig. 17.

Various forms of uric acid crystals from acid urine. Urine containing these crystals is generally of a specific gravity above 1020, is darker than usual, and contains much urea.

173. URATE OF AMMONIA

Is always present in urine, and is the most common urinary deposit; it is not a sign of disease, if not constant; it generally diagnoses some little want of action of the skin. The cloud varies considerably in its colour, from quite white to a pale fawn, pink, or red. Upon the application of heat it always disappears in solution. Upon examining a drop of urine containing this salt under the microscope, it is easily discovered. A minute glistening molecule is seen struggling into focus, vibrating, and in active motion; presently others appear, and they approach each other, and bound away, again to approach; they

increase in size as evaporation continues, when, having attained their full growth, they attach themselves one to another, and the characteristic deposit of urate of ammonia is disclosed to view.

174. There are other forms of urate of ammonia deposits, as the globular, the foliaceous, &c., but the amorphous is by far the most common.

FIG. 18.

Urates.—On the left-hand side of the figure various forms of urate of ammonia. On the right, urate of soda. Some crystals are shown attached to the pellicle of phosphate of lime, sometimes seen in evaporating urine.

175. Urine containing OXALATE OF LIME is usually of a dull, light-amber colour, of very variable specific gravity, containing much urea and epithelium. The only safe mode of diagnosing this salt is by the microscope. Upon placing a little upon a slide, and examining with a quarter object-glass, many octohedral crystals of the oxalate may be discovered: they appear to be formed of two four-sided pyramids attached to each other by their bases; their more common aspect is, by transmitted light, a square, with two diagonals crossing in the centre.

176. If urine has been kept some time, these crystals, of small size and in small numbers, are generally to be found; but when they crowd the field, as occa-

sionally they do, and are of very large size, they diagnose a form of disease of very troublesome character.

FIG. 19.

Oxalates.—The figure to the right represents oxalate of lime crystallizing in urine containing many vibriones, and becoming alkaline from the presence of ammonia. That to the left, oxalates in acid urine. A few epithelium scales are shown, with the crystals.

177. NEUTRAL URINE.

This form of urine is pale, of low specific gravity; upon cooling, it throws down a cloud of phosphate of lime. When neutral, urine contains a great excess of the phosphates; immediately after passing, it becomes turbid, and throws down a very large deposit. Under the microscope it is found to consist of a powdery, amorphous aggregation, which immediately disappears upon the addition of a little nitric acid. Upon heating the urine a still greater amount of the salt is thrown down. I have frequently seen phosphate of lime deposited in urine having an acid reaction; the reaction must be owing to the presence of an acid salt, and not from free acid, otherwise the phosphate of lime could not be deposited.

178. ALKALINE URINE.

The colour and specific gravity of this form of urine is very variable. It must first be determined whether the alkalescence is derived from a fixed or a volatile alkali. Recent urine is seldom alkaline from ammonia; the mode of discovering the form of alkali is by the microscope: a drop is slightly evaporated, and examined under the microscope; if the amorphous phosphate of lime appears, the urine is alkaline from the alkaline phosphate of soda.

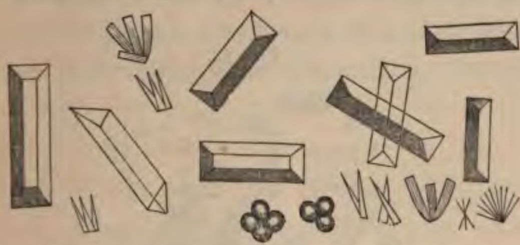
FIG. 20.

Phosphates.—The upper figure on the left-hand side represents the pellicle of phosphate of lime; the lower, the amorphous deposit of phosphate of lime. The various crystals on the right side of the figure are phosphates thrown down by the addition of ammonia to heated acid urine.

179. If the beautiful crystals of triple phosphate of ammonia and magnesia are discovered, then the urine is alkaline from the presence of ammonia: this latter form of urine contains much epithelium and mucus.

180. These are the chief deposits with which I shall have to deal; and I now proceed to show the mode of detection of albumen in urine.

FIG. 21.



Phosphates from ammoniacal urine. Crystals of the triple phosphate of ammonia and magnesia. The crystals at the lower part of the figure are more uncommon forms found in decomposing urine.

If the urine which has been set aside is of low specific gravity, albumen may be suspected, and should be tested for.

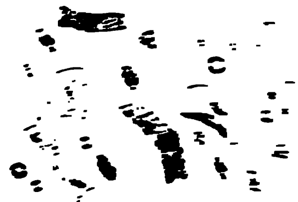
Albumen is discovered by adding a few drops of nitric acid to the urine, when, if albumen is present, it will become turbid. However, as some salts are thrown down by nitric acid, the urine should be boiled, when, if the cloud remains, albumen may be considered present; if the urine becomes clear, the cloud consisted of salts, which have again been dissolved by the aid of heat.

181. On letting the suspected urine rest some time, and taking a drop from the very bottom of the vessel, either casts of the urinary tubes, blood-corpuscles, or pus-cells may be discovered, as one of these generally accompanies the escape of albumen from the vessels.

182. I consider the examination by the microscope of a drop of urine from the bottom of the vessel far preferable for the detection of albumen, than the agency of heat and nitric acid, as I have on more

[illegible]

[illegible]



[illegible]

[illegible] the presence of albumen. The pe[illegible] [illegible] also is a very good microscopic t[illegible] for the presence of albumen in acid urine.

SUGAR.

183. If the urine be of high specific gravi[ty,] sugar may be suspected, and should be tested f[or.] Diabetic sugar crystallizes in knots, or feath[ery] groups, of minute rhombic transparent crysta[ls.] Urine containing the smallest proportion of sugar, [if] exposed for a few hours to a temperature above 7[0°,] and a drop taken from the surface be examined und[er] the microscope, numerous very minute ovoid particl[es] will be discovered. In the course of a few hou[rs] they become enlarged, and appear as distinct ov[al] vesicles, which rapidly become developed into th[e] species of confervoid vegetation to which the ter[m] "torula" has been applied.

184. Under favourable circumstances, this fungus is of very rapid increase; in fact, its growth may be observed under the microscope, with a little patience. It has been described by Dr. Hassall in the volume

FIG. 23.

The penicilium glaucum in various stages of growth, as seen in acid urine containing some form of proteine, or sugar.

of the *Transactions of the Medico-Chirurgical Society* for 1853. The chemical tests are easier and more satisfactory than the microscopic. The specific gravity may vary from 1030 to 1060,—healthy urine 1015 to 1025, according to Dr. Prout. Diabetic urine is paler, has a turbid, wheyish appearance, of a greenish tinge; if allowed to stand for a considerable time after the formation of the sugar fungus, or fermentation globules, it will undergo fermentation.

185. Upon boiling the suspected urine with nearly half its bulk of liquor potassæ, if it contains sugar it will turn brown or nearly black. A more delicate test is that used by Trommer :—"I usually take a test-tube of about seven inches long, fill three-fourths of an inch of it with the suspected urine, and heat it with two scruples of carbonate of potash. I add five or six times the volume of spirit of ·845 and

again boil; a few drops of a solution of sulphate of copper are then added, and heat again applied. If much sugar is present, the reduction of the oxide of copper to a state of sub-oxide occurs very quickly in the lower stratum of solution of carbonate of potash, and the fluid becomes of a yellow, red, or copper colour; if the quantity of sugar is very small, the reduction still takes place, but much more gradually. If, however, no sugar is present, the solution of potash remains of a blue or bluish-green colour."

UREA.

186. This is the most important ingredient of urine. Nearly half the solid constituents of the secretion is composed of urea, 270 grains out of 610 being passed daily by a healthy man. (Becquerel.) It is chiefly important on account of its being the vehicle for the elimination of the principal portion of waste or used nitrogen from the system.

The formula for urea is $C_2H_4N_2O_2$.

It is very important that the amount and quality of the urea passed in disease should be ascertained.

187. Dr. Edmund Davy, in the *Philosophical Magazine* for June, 1854, has described an exceedingly simple method for determining the amount of urea in a given quantity of urine, which I consider well worthy of being further made known. "The method I propose is one of extreme simplicity, and can be performed by almost any one in a very few minutes, and is capable of yielding results sufficiently

accurate for all practical purposes. It is founded on the fact I have recently observed, that urea is very readily decomposed by the chlorides, or rather hypochlorites of soda, potash, or lime; and its constituent nitrogen is evolved in the gaseous state, and from the quantity of gas evolved I estimate the amount of urea present.

188. "I take a strong glass tube—that which I would recommend as being convenient for this purpose is a stout tube having a bore of half an inch in diameter, and capable of holding from two to three cubic inches. A tube having this bore and about fourteen inches in length, will hold two-and-a-half cubic inches, which will be quite large enough. Each cubic inch of it should be divided into tenths and hundredths of a part of a cubic inch. This I fill more than a third full of mercury, and afterwards pour in carefully a measured quantity of urine to be examined, which may be from a quarter of a drachm to a drachm or upwards, according to the capacity of the tube; then holding the tube in one hand near its open extremity, and having the thumb in readiness to cover the aperture, I quickly fill it completely full with a solution of the hypochlorite of soda (taking care not to overflow the tube), and then instantly cover the opening tightly with the thumb, and having rapidly inverted the tube once or twice to mix the urine with the hypochlorite, I finally open the tube under a saturated solution of common salt in water, contained in a steady cup or small mortar.

189. "The mercury then flows out and the solution

of salt takes its place, and the mixture of urine and hypochlorite being lighter than the solution of salt, will remain in the upper part of the tube, and will therefore be prevented from descending and mixing with the fluid in the cup. A rapid disengagement of minute globules of gas soon takes place in the mixture in the upper part of the tube, and the gas is there retained and collected. The tube is then left in the upright position till there is no further appearance of minute globules of gas being formed, the time being dependent on the strength of the hypochlorite and the quantity of urea present; but the decomposition is generally completed in from three to four hours; it may, however, be left for a day if convenient, but not longer, as oxygen may be evolved from the hypochlorite of soda.

190. "The fifth part of a grain of urea should furnish by calculation 0·3098 parts of a cubic inch of nitrogen gas at 60° F. and 30′ bar.; the same quantity of urea treated as described furnished in one experiment 0·3001, and in another 0·3069 parts of a cubic inch of gas at the same temperature and pressure; which shows that the calculated quantity of nitrogen differs from the amount of nitrogen gas obtained by only a few thousandths of a part of a cubic inch. I may observe that I was obliged to operate on such small quantities of urea, on account of the graduated tube I had at the time being only of one cubic inch capacity.

191. "Seeing, then, that the quantity of gas evolved agrees so very closely with the calculated amount of

nitrogen present in a certain quantity of urea, I take the calculated amount as being the more correct; and knowing the relation that exists between a certain quantity of urea and nitrogen, I can from the quantity of gas evolved in any case easily calculate the amount of urea present by the simple process of rule of three. Thus the fifth part of a grain, or 0·2 of a grain of urea, gives by calculation 0·3098 parts of a cubic inch of nitrogen gas. Then 0·3098 : the volume of gas found : : 0·2 : to the required quantity of urea; or multiplying the first and third terms by 5, we have 1·549 cubic inch of gas representing one grain of urea, which is a simpler proportion.

192. " An excess of the hypochlorite should be used —five or six times the quantity of the urine to be examined. I found by experiment that one grain of urea requires somewhere about half a fluid ounce of the ordinary sodæ chlorinatæ liquor for its complete decomposition. The amount of mercury employed requires some little attention. It should, as a general rule, be never less than the volume of gas produced; for if the volume of gas evolved is more than that of the mercury used, it will be more than that of the solution of salt, and therefore some of the mixture of urine and hypochlorite will be forced out of the tube before it is completely decomposed, and consequently some of the gas will be lost.

193. "In cases where ammonia or uric acid occurs in more than ordinary quantity, these substances must be separated by the usual means employed before having recourse to my method.

"The reaction which appears to take place in the process seems to be the following:—The hypochlorite of soda acting on the urea gives rise to the formation of carbonic acid, water, and chloride of sodium, together with the evolution of nitrogen gas. Thus—

$$\underset{\text{Urea.}}{C^2.\,H^4.\,N^2.\,O^2.} + \underset{\text{3 Hypochlorite of soda.}}{3(Cl,O.\ NaO)} = 2CO^2 + 4HO + 3Cl.Na. + N^2.$$

"The nitrogen is evolved and the carbonic acid is absorbed by some of the hypochlorite of soda in excess, for I find that this salt absorbs carbonic acid very quickly without evolving any other gas; and I failed in several experiments to detect the smallest portion of carbonic acid in the gas produced by acting on urea, though I have always noticed the presence of a very minute quantity of oxygen in the nitrogen gas."

194. This is a very ready method of determining the amount of urea; and having made use of it myself, I can recommend it to others; the only thing likely to mislead is the variable strength of the liquor sodæ chlorinatæ: this must be obviated by using a great excess.

195. Urea appears to be formed in the capillary system, and is merely separated by the kidneys from the blood: but urea has two states in the urine—one in healthy acid urine, in which it does not readily decompose; and the other in neutral and alkaline urine, where the fermenting mucus soon causes a change in the chemical condition of the urea: in the latter instance it soon becomes converted into car-

bonate of ammonia, some of the latter flies off, the carbonic acid combines with lime which is precipitated; phosphate of lime is also precipitated, there being no acid to retain it in solution; a part of the ammonia combines with the acid phosphate of magnesia, and converts it into a bibasic ammoniaco-magnesian-phosphate.

196. Urea is the result of the conversion of albumen into the gelatinous tissues, and gelatine into urea, effected by oxidation. The quantity is increased in the urine by an animal diet, and decreased by vegetable. Urea is excessive in the urine in inflammatory affections, in fevers of an acute type, in some forms of indigestion, and in the early stages of diabetes. It is diminished in diseases of a low type—low typhoid fever, chlorosis, in some forms of indigestion where the appetite is bad, and in confirmed diabetes.

URIC ACID.

197. Uric acid is the result of the conversion of fibrine into the muscular and other tissues, and from them into uric acid; and is the consequence of waste and oxidation. The amount of uric acid in the urine is a very fair test of the consumption of blood-corpuscles going on in the system, and is increased in high fevers, gout, some forms of indigestion, &c. It is decreased in chlorosis, anæmia, and low forms of disease; and this more so than the urea, as I have noticed that, although the pale urine in hysteria may contain but a mere trace of uric acid, there may be a

large quantity of urea. Uric acid and the urates are associated with the colouring matter of the urine, as the fibrine is found to be with hæmatin in the corpuscles; the colouring matter is one of the modes of excretion of the fatty constituents of fibrine. In the urine it is slightly volatile, as the peculiar smell of fresh urine is owing in a great measure to it.

OXALATE OF LIME.

198. Oxalate of lime is a morbid product, and when present is always a sign of derangement, generally, however, from indigestion, although it may result from malassimilation, and it then warns us of grave disease. In the stomach, saccharine substances are changed morbidly into oxalic acid instead of into lactic acid. During secondary assimilation, oxalic acid may be formed from the gelatinous tissues, or from the fibrinous tissues by oxidation and misdirected nerve-force.

199. Uric acid, oxidized by peroxide of lead, is converted into oxalic acid, urea, and allantoin. (Becquerel.) Also, distilled in a retort by heat, uric acid is converted into urea, cyanuric acid, hydrocyanic acid, and ammonia. (Becquerel.) All these changes, which are produced in the laboratory, may be also effected in the capillary system, nerve-force being perverted. Wœhler discovered that a watery solution of ammonia, having been saturated with cyanogen, contained oxalic acid.

The gelatinous tissues during health in the capil-

lary system are converted by oxygenation into a saccharine principle and urea. In some forms of enervation into carbonate of ammonia and oxalic acid.

200. ALKALINE URINE

Is of two distinct kinds—the one arising from some error of digestion, the other from disease. In the former, the urine is passed of an alkaline reaction, cloudy, throwing down the amorphous phosphate of lime, increased by heat, cleared by nitric acid. It is occasionally passed in the middle of the day by most people, and may result from some form of food taken. Diet has a great influence upon the reaction of the urine. A vegetable diet generally causes an alkaline condition of the urine, the acetates, tartrates, and citrates appearing in the urine as subcarbonates of potash and soda (Wœhler); but with a meat diet the urine should be acid.

201. I quote the following admirable remarks from M. Claude Bernard's "Experimental Physiology applied to Medicine," reported in the *Medical Circular:*—

"This urine, extracted from the bladder of a rabbit is seen to be turbid, is found to be alkaline, to effervesce when an acid is added, and to contain very little urea. The urine of five or six other rabbits was also examined, and was found in each case to possess the same chemical and physical properties; and this is only in accordance with what is generally admitted—that the urine of the herbivora is always alkaline,

contains carbonates in no small quantity, and has but little urea; while the urine of carnivora is acid, and contains much urea, and no carbonates.

202. "But here is a rabbit of a size similar to the others, from which we extract the urine, which you see in this case is clear, limpid, and acid, and, moreover, contains much urea, and does not effervesce with acids. Is it, then, an exceptional fact that in the rabbit the urine which you see, should be analogous to that of the carnivora? It is now eight years since I first remarked the urine in rabbits and horses is sometimes found to be acid.

203. "In accordance with the principle I have just pointed out to you, I did not look upon this as an exception, nor regard it as a fact for the existence of which there could be no reason. On the contrary, I was convinced that the difference arose from some particular circumstance, which I next endeavoured to find out, and soon succeeded in discovering that the urine of the herbivora, when they have for a while been deprived of food, is always acid, and charged with urea, as in the carnivora. By thus ascertaining the circumstances under which these phenomena are observed, the fact that the urine of the herbivora is generally alkaline remains undisturbed, and we now further know that when herbivora are deprived of food, their nourishment is then derived from their own substance, that is, from their own blood."

204. The alkalinity of the urine arises from the presence of some alkaline salts, and there being no free acid, the salts may be carbonates of potash or

soda, or the alkaline phosphate of soda. The phosphate of lime thrown down may be distinguished from urate of ammonia by not attaching itself to the sides of the vessel as does the latter salt—by being dissolved by acids, and increased in quantity by heat. Microscopically, they are almost alike.

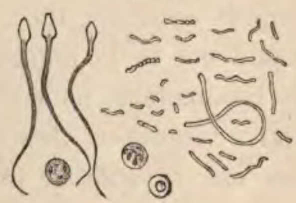
205. The other form of urine, alkaline from the presence of ammonia, is frequently the result of disease of the bladder and appendages, or the lower portion of the spinal marrow; it, however, occasionally accompanies low forms of disease. It may be passed acid, and perfectly clear, but a thick cloud soon accumulates at the bottom of the vessel, which, upon examination with the microscope, is found to consist of mucus cells and epithelium scales, in mucus. Upon watching this deposit carefully, the mucus, which is first transparent and not to be detected, will shortly be converted into innumerable molecules of the finest description, in active vibration; they increase in size, attach themselves one to another in rows, still in active motion, and dart about like minute worms. These are termed vibriones, and they attach to themselves other molecules from the molecular mucus around, and when this is exhausted, from the breaking-up epithelium scales and mucus cells.

206. The urine has a peculiar odour, resembling broth, and a pellicle rises to the top. After resting until the colour of reddened litmus-paper is restored, the pellicle is found to consist of a powdery amorphous deposit of phosphate of lime, with many prismatic crystals of the triple phosphate of ammonia and

magnesia, amongst which thousands of most active vibriones disport, and perform their duty of changing the urea into carbonate of ammonia. Upon proceeding deeper, and taking a drop from the lower stratum, large epithelial scales will be found mixed with the vibriones, phosphate of lime, and triple phosphate.

207. After a day or two, the urine will become fœtid, giving off an odour of garlic; and small rosettes of crystals of phosphates of soda and ammonia will be found mixed with the other crystals. Upon boiling this urine much gas is given off; it is cleared, and a flocculent mass of the binoxide or tritoxide of proteine, full of bubbles of gas, floats to the top.

FIG. 24.



On the left of the figure, three spermatozoa, two spermatic globules, and a blood-corpuscle are shown. On the right, vibriones in different stages of development. The whole are magnified 400 diameters.

208. The continued motion of these minute active vibriones, which rapidly fill the whole vessel, and form a scum upon the top of the urine, appears to act upon the urea as a ferment, which, combining with atoms of the gases composing water, is soon converted into the carbonate of ammonia, thus—

$$\begin{array}{ll} \text{Urea . . .} & C_2\,H_4\,N_2\,O_2 \\ \text{4 atoms water} & \ldots H_4 \ldots O_4 \\ \hline \end{array}$$

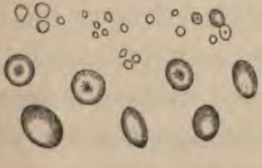
$$C_2\,H_8\,N_2\,O_6 = C_2O_4 + N_2H_8O_2 = 2\,(NH_3\,CO_2\,HO),$$

two atoms of carbonate of ammonia. This takes more or less time, according to the fermentable state of the mucus, and the urea being strong or weak. It may take place in a few hours, or some days.

209. The scum of vibriones at the top of the urine has a caseous appearance and smell, but its chemical reaction to tests is not exactly that of caseine: it is an oxide of proteine, probably the tritoxide of Mulder. The thick scum at the top is owing to the urine being in contact with the atmosphere, and oxygenation going on more actively. The urine beneath is of the same character as that at the surface, but the vibriones, &c., are not so closely packed: their movements, therefore, are more active.

210. Many new products appear during the alkaline decomposition of the urine. The carbonate of ammonia decomposing, combines with lime and magnesia as subcarbonates—neutral phosphate of lime, neutral ammoniaco-magnesian-phosphate, and bibasic ammoniaco-magnesian-phosphate. Carbonates do not exist naturally in the urine; their presence indicates the transformation of urea into carbonate of ammonia, or a wholly vegetable diet.

FIG. 25.

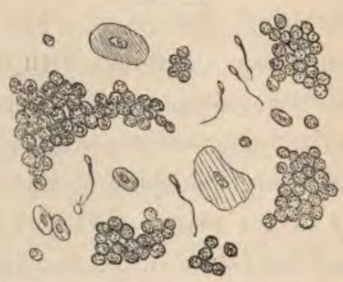


Carbonate of lime found in alkaline urine.—The larger granules are formed in the glandular portion of the prostate, and are occasionally, although rarely, passed with the urine.

MODE OF EXAMINING URINE FOR SPERMATOZOA.

211. The urine being passed into a glass vessel, a small portion is immediately transferred to a phial, corked, and allowed to rest upon the cork. Upon holding up the larger vessel to the light, small cloudy masses are seen floating about in the urine; these are plugs of mucus which block up the canal of the urethra, the largest one is derived from the prostatic portion; upon being removed by a glass tube or camel's-hair brush and transferred to the slide, spermatozoa may, when present, be at once detected associated with mucus cells in a glairy fluid.

FIG. 26.



Mucus cells, epithelium cells and scales, and spermatozoa, from the floating plug of mucus found in urine immediately after it is passed.

212. Spermatozoa sink in urine, so that upon allowing the phial to rest upon the cork, if there are any present, they may be rapidly detected by removing the cork and rubbing it upon the slide, when upon focussing the spermatozoa will appear. The urine should be examined before the salts commence to crystallize, otherwise they may very much inter-

fere with the inspection, especially urate of ammonia and phosphate of lime, which undergo vibration whilst forming, and may distract the attention of a beginner from the spermatozoa.

FIG. 27.

The deposit from the cork, rubbed upon the slide; showing mucus or pus-globules, vibriones, crystals of oxalate of lime, and urate of ammonia, spermatozoa, and epithelium scales.

213. In examining discharges from the urethra, the manipulation slightly differs, there being more difficulty in detecting the spermatozoa, if there be very few present; but if they are in large quantities, which they generally are when passed in any form of discharge, they are easily made out. A small quantity of urine should be first placed on the slide, and then a drop of the discharge in it: upon placing this beneath a quarter object-glass, its nature may at once be detected; if it be a mere simple mucous gleet, many mucus cells in a glairy albuminous fluid are seen; if the discharge contain pus, the pus cells are discovered floating in a greenish fluid: there may be epithelium scales in both; if spermatozoa are present, they are seen together with mucus cells, epithelium, and spermatic granules.

214. Much care must be taken in these examinations, and if spermatozoa are not detected immediately, a second investigation should take place, as much injury may be done the patient by giving a decided opinion that no semen is discharged. If the patient make water in your presence, which is decidedly preferable, the last few drops are the most likely to contain spermatozoa, from the straining of the muscles to free the urethra from them, squeezing out the secretion.

215. These are the principal and most useful methods of examining the urine; but I have not given the quantitative analyses, because such examinations would take up more time than a medical man in active practice could afford to devote to them; for further research I can recommend Dr. Simon's *Chemistry*, translated by the Sydenham Society; Dr. Bence Jones' *Animal Chemistry;* Dr. Golding Bird on *Urinary Deposits;* Mr. Bowman's *Manual of Medical Chemistry*, &c. These will afford a wider field for research for those desirous of entering more into the minutiæ of the subject. What I have given is the every-day mode of examination of the urine, which I find most useful and expeditious, and which any practitioner may, without giving up too much of his time, make use of. A microscope is indispensable, and I can recommend those made by Mr. Pillischer, of New Bond-street, as being moderate in price and excellent in quality.

PART II.

CERTAIN AFFECTIONS OF THE NERVOUS SYSTEM, THE SYMPTOMS OF WHICH ARE OBSCURE, AND WHICH, IF NOT ALLEVIATED, WOULD DEVELOPE THEMSELVES INTO ORGANIC DEGENERATION, FATAL DISEASE, OR INSANITY.

216. There are a class of cases which come before the practitioner in medicine which frequently baffle our best efforts to discover the organ or system affected, and, from the Protean character of the symptoms, can be classed under no head—can be treated upon no regular plan—and in many instances, in spite of our most earnest endeavours, do not yield to treatment.

217. It is of *the obscure forms of nervous affections* concerning which I propose to treat, for one reason,—because it is to them chiefly we owe the class of charlatans who have sprung up around us in such luxuriant crops—who fill our papers with advertisements—who compound infallible nostrums—who rob the patient of his money, his health, and his peace of mind—and, to wind up the whole, draw down opprobrium on the Science of Medicine, the most glorious of all the sciences, gathering her experience from each, and uniting them to form a bright particular star, spreading around God's chiefest gift to man—Health.

218. And do we not owe to ourselves much of this

contumely? Surely. Many a case is pooh-poohed and ascribed to fancy which should be narrowly and carefully watched; and if the mind is affected—which it frequently is—not by coldness to throw back the confidence reposed in us, but by taking interest in their troubles (the mental ones the result of the reflection of some bodily ailment), relieve both body and mind, and perhaps prevent, or stave off, organic disease, or mental fatuity.

219. These affections result from partial paralysis of some portion of the sympathetic system of nerves, either of their centres or of their peripheric terminations, thus upsetting the healthy process of digestion and assimilation in some portion of its extended course; causing functional derangements, nervous irritability, and frequently sympathetic complication of the more important organs. There are many causes which combine to originate affections of this description. The chief of these are,—hereditary tendency, malarious influence, an overworked brain, and any exhausting habit or discharge. The method of detection, and the treatment of each case brought before us, is exceedingly difficult, for there are no two exactly alike, and it is only by experience that it can be successfully accomplished.

220. Without further preface I shall now enter into their consideration, merely premising that the symptoms of all being so much alike, we cannot look to them for a classification; but as the secretions, which are wholly under the influence of the sympathetic, are generally very much deranged, and as the

urine is the one most convenient for examination, I have taken the different characteristics of that secretion, as the heads under which to classify the symptoms brought before us, at the same time not binding myself down to any stringent rules, but allowing free scope for observation.

URINE WITH AN ACID REACTION.

DEPOSITS, { *Urate of Ammonia.* / *Uric Acid.* }

Urate of Ammonia.

221. When this salt is the only one deposited, the prognosis derived from its discovery is almost always favourable, because it is merely an increase of a normal constituent of the urine, and is the most common of all. After an excessive meal, this salt, even in health, is frequently deposited, especially if there be not much fluid drank. It is the invariable concomitant to a cold, or any check to the natural transpiration, and where habitual, it denotes a decreased action of the skin.

222. Although morbid, it is the one least of all so, and will generally require but little treatment and care to return the patient to health. Exercise should be recommended—a glass of water the first thing in the morning, another the last thing at night—an occasional warm bath, friction to the skin—an alterative pill at dinner (a little rhubarb and dilute aloes) daily for a week, will generally remove the deposit of

urate of ammonia from the urine, at the same time the accompanying symptoms will disappear.

223. Uniting with the deposit of urate of ammonia is the colouring matter of the urine, and this is of far more importance, and a better guide than the salt itself; urate of ammonia may be perfectly white, and passing through every gradation of colour—fawn, brown, up to brick-red. As I have before mentioned (paragraph 197), the colouring matter of the urine is derived from the hæmatin of the blood, associated with the oily constituents, so that the less colouring matter, the less blood-corpuscles are there broken up, and the less nervous tonicity in the system. If, then, the deposits of urates be white, we know that we shall not be doing wrong in increasing the tone and blood-corpuscles. This can be done by nourishing diet, wine, cod-liver oil, iron, &c. If, on the contrary, the deposits be of a brown-red colour, we know that the blood-corpuscles are either in excess or are being broken up too rapidly; in other words, there is a feverish tendency; alterative medicines are required —a mercurial purge, saline medicines, followed by quinine, &c. Much may be learnt by merely looking to the colour of the urine.

224. However, in acid urine, of which I am now treating, there is almost always an apparent excess of power in the system, an excess of blood-destruction; the urine is high coloured, acid, and of high specific gravity. Do not let me be misunderstood, when I state there is an excess of power; when there is much blood-destruction, there is always an excess of power,

although at the same time the centres of the sympathetic may be almost paralysed; so that this excess of power is always followed by a corresponding diminution of power. By watching the colour of the urine, therefore, we know when to cease our treatment for fever, and commence the rebuilding of the system by appropriate medicaments.

CRYSTALS OF URIC ACID.

225. Uric acid crystals may be discovered in the urine without there being any abnormal quantity secreted by the kidneys; this is because the uric acid is freed from the ammonia, soda, &c., with which it is associated, commonly by some acid having a stronger affinity for those bases, as the lactic. The presence of uric acid crystals, then, acquaints us with the knowledge of an increased secretion of acid by the kidneys, generally concomitant with abnormal acidity in the stomach.

226. When uric acid is actually in excess, then we know that there is a destruction of the fibrinous portions of the system going on in the capillary laboratory, and that there is tendency to fever; the urine is high coloured, from the accompanying oily colouring matter; and of high specific gravity, from the increased amount of solid constituents.

Case.

227. An elderly gentleman, robust and florid, will be noticed to have been lately becoming peevish; he has been more particular in having everything about

him done more quietly; he cannot bear a noise; the servants annoy him with the clatter of the dishes; no one seems to please him; he is continually upbraiding some one; things do not go right with him; he is not sure things are quite safe in the City; his children are not sufficiently dutiful; he is snappish. Upon being consulted, he will detail a long list of troubles, many of them exaggerated if not altogether imaginary. What he complains of will be chiefly concerning his family or business, dwelling upon little things which a healthy brain would pass over. Upon inquiring into his own ailments, he will tell you that he is not well, but he does not exactly know what is the matter with him; he is costive; his skin is dry and feverish; his appetite is capricious; he is fond of made dishes, and likes his wine: his water he has noticed is thick, throws down a yellow or reddish sand—has noticed it for some time. He has frequent headaches, with giddy feelings, sometimes so bad that he would fall if not prevented; has noises in the ears: he will very likely wander back to some tale of his family, disobedience of a son, &c. On inquiry, it will be found, probably, that he has been subject to gout, but that he has not had an attack for some time.

228. The indications in this case are, to re-establish the function of the skin, by inducing perspiration, the most preferable diaphoretic being the vapour-bath; this, used occasionally, will be found of the greatest use in arresting excessive secretion of acid, and restoring the balance between the kidneys and

skin. The organs of digestion are very much disordered. Small doses of blue pill at night, with a saline draught, containing the bicarbonate of potassa with sulphate of magnesia, the following morning, may be given several nights in succession with benefit. A saline draught, containing half a drachm of bicarbonate of potassa, with ten grains of citric acid added, and taken effervescing thrice daily, two hours after meals, will be found of great benefit in counteracting the acidity of the urine.

229. Change of diet, however, is the best mode of arresting this form of disease. A mild, nutritious diet, containing less of the nitrogenized principles—such as arrow-root, bread and milk, a very small quantity of meat cooked quite plainly, the entire suspension of wine and beer, with, if required, a little cold brandy-and-water—will generally, after a short time, entirely remove this train of symptoms, and the healthy tone of the mind will return with the improved state of the system.

230. A case of a different description is occasionally met with. A young lady, accustomed to none but carriage exercise, fond of high living, reads a good deal; has perhaps met with some disappointment; complains of a pain about the region of the heart—has flutterings there; the pulse occasionally intermits; suffers from indigestion—has done so for some time; is in great trouble about her heart; fears she may die suddenly: it has made her very uneasy, and she feels very unhappy; does not think she will

ever get well. On examining her water, uric acid crystals are found.

231. The chief indication here is exercise. I have frequently observed in this class of cases, that there is an extreme antipathy to walking, which can hardly be overcome. Where such is the case, and the means of the patient sufficient, I generally recommend horse exercise, which is very much enjoyed, and the mind and body are both invigorated and improved by it. A little opening medicine, and a gentle tonic—the ammonio-citrate of iron—will usually effect a cure; the diet of course must be attended to, as in the last case.

232. These cases must not be confounded with hysteria; for although the symptoms somewhat resemble, one glance at the urine will be sufficient to point out the difference. As a rule, it may be taken for granted, that where uric acid is deposited, the patient will bear alterative treatment. The medicines most suited for acid urine with uric acid deposits, are gentle mercurial and saline aperients. The following is a good formula:—

℞ Hyd. chlor., gr. j. or ij.
Pulv. antim. tart., gr. $\frac{1}{6}$ or $\frac{1}{4}$.
Ext. acet. colchici, gr. j.
Ft. pil., h. s. sumendus.

℞ Potassæ bicarb., ʒss.
Sol. mag. sulph., ℥ss. to ℥j.
Tinct. zingib., ♏ xv.
Tinct. aurantii, ʒss.
Aqua ad ij.
Ft. haust., p. c. m. sumendus.

233. A vapour bath at night, to act powerfully on the skin. The medicine to be taken during the continuance of the excess of acidity, should be the effervescing saline mixture before mentioned, with an occasional rhubarb-and-magnesia draught in the morning. The diet should be as directed. It is seldom that this form of urine is persistent, if these remedies are carried out thoroughly. What may be feared is, that the patient will too soon return to the diet and mode of living which induced it.

Excess of Uric Acid excreted by the Kidneys.

234. This is a more serious symptom than the former, and indicates a more deeply-seated disease. Of its acute forms, such as we see in acute fevers, pleurisy, &c., it is not my province to treat; but in chronic ailments its presence is far more common than is generally supposed, and when detected is of vast use to the practitioner. In chronic cases, where the urine is habitually passed in small quantities, of an increased specific gravity, high coloured, with uric acid in a larger proportion than in health, serious organic disease should be suspected. Upon examining the patient, the expression will be found to be anxious, tongue red, pulse quick, and skin dry; there is a feverish tendency; and we know, from the condition of the urine, that alterative medicines are required before resorting to tonic or stimulant treatment,—thus, a mercurial aperient or two, followed by (if a syphilitic taint be suspected) the bichloride of mercury, or

iodide of potassium. If the patient be of a rheumatic tendency, colchicum should be substituted for the mercury or iodide: the vapour-bath, to increase the transpiration from the skin, with appropriate diet.

235. There are two diseases, which frequently in the early stages are accompanied by this form of urine, and it is to warn against the treatment that I have recommended that I mention them—phthisis pulmonalis and cancer. These are essentially diseases of debility, and although there may be fever—although there be much blood destruction—although there may be an excess of uric acid and colouring matter in the urine, the treatment must be invariably tonic and stimulant: no lowering medicines can be borne, as they will always in the long run do harm, although apparently at the time beneficial.

236. Accompanying true acid urine, where the urine is passed acid, and remains so for some considerable time (many days) without undergoing alkaline fermentation, there are few, so called, nervous symptoms: the symptoms are more frequently of a sthenic type, and the diseases generally openly declare themselves. It is to the affections accompanying the next form of urine to which the title of this work may be more justly applied.

Urine passed Acid, } *Soon becoming Alkaline.*
Neutral Urine, }

Deposits, { *Phosphates of Lime, Soda, &c.*
Oxalate of Lime.
Vibriones, or Proteine Oxides.

237. This form of urine is generally passed in large quantities, more frequently than natural, is of low specific gravity, contains little colouring matter, and smells like new flannel wetted, whilst warm. If passed acid, which it usually is in the early morning, it in a very few hours in the summer becomes alkaline from the presence of ammonia; it throws up a pellicle upon its surface of phosphate of lime, although the lower strata may be still acid; it usually throws down a voluminous cloud of epithelium and mucus, which acts as a ferment upon the urea, rapidly converting it into the carbonate of ammonia. With the aid of the microscope, the various deposits of phosphate of lime and phosphate of soda are easily made out; also, in many instances, the urine is crowded with crystals of oxalate of lime, accompanied by countless millions of vibriones (chemically speaking, a proteine oxide), derived from albuminous food which has undergone semi-digestion, but which, through want of nerve force, is not converted into blood, but is passed through the kidneys. It has, however, undergone a certain amount of vital change, and has had imbued into it a species of pseudo-vitality, sufficient to originate vibratile motions in each component particle, as may be seen in the vibrione.

238. If this urine be set aside, and examined with the microscope from time to time, the vibriones will be found to undergo no higher change, but will gradually separate into their original molecules, stripping off by degrees their proteine coat, and will at length fall to the bottom of the vessel as the finest conceivable sand, consisting of phosphate of lime. This is a process of weeks, sometimes of months. I have, however, watched it sufficiently often to be sure of the fact.

239. The above-described urine accompanies a series of symptoms which are most distressing to the patient, and frequently also to the medical attendant, from their obscurity and the inability to discover the seat of the disease, as also from the secondary effects upon the brain, induced by the condition of the blood. The brain is in many cases considered, both by the patient and friends, to be the organ affected. In several most interesting cases I have known patients treated for insanity or disease of the brain who have had nothing the matter with that organ, and who have either eventually died, or been immured during the remainder of a miserable life in a madhouse.

240. I shall first proceed to describe some of the symptoms of which patients complain, then state what I consider the causes of the affection, and finally the treatment most likely to effect a cure.

Under the head of the oxalic acid diathesis, Dr. Watson thus describes the symptoms accompanying that condition; and as it would be impossible to do so

more graphically, and as I can fully corroborate their accuracy, I shall quote his words:—

"The persons who manifest this disposition are usually dyspeptic, sometimes very much so, sometimes very slightly. They are uneasy during the assimilation of their meals, suffer flatulence when the stomach is empty, prefer vegetable diet to animal, are fond of sweets, especially of sugar; they are liable to boils and carbuncles, and to scaly cutaneous eruptions. According to their original temperament, they are nervous and irritable, or dejected and desponding in mind. A nephritic attack relieves them from all this discomfort, for years, perhaps. When the diathesis is strongly marked, the skin, Dr. Prout says, is apt to assume an unnatural appearance, difficult to describe, but the colour of which may be said to vary from dull greenish yellow in the sanguine to dark olive or livid in the melancholic temperament. Dr. Golding Bird describes them as highly sensitive and irritable, hypochondriacally apprehensive of impending evil, full of gloomy fears concerning their bodily and mental powers, dyspeptic, weak, and usually emaciated."

241. I extract the following case from my note-book, although a slight one, and readily yielding to treatment, as it points out the advantage of a correct diagnosis:—

A gentleman consulted me for indigestion, which he had been suffering from for some years, more or less, although it had not troubled him very much; it had now, however, become unbearable; he could not

enjoy a meal, and after about an hour, a craving for food returned, without any appetite, the idea being, that food would ease the sensation he suffered from. He was greatly troubled with flatulence, from the first thing in the morning to the last thing at night; he suffered no *pain*, but very uncomfortable sensations. Another symptom which had lately appeared, was a continual flow of saliva, his mouth constantly filling with it, which, when swallowed, increased the uneasiness and flatulence; and he was, therefore, frequently spitting. He had lately noticed that he was getting despondent; he exaggerated little troubles, until they swelled into misfortunes; he was perfectly aware of the fallacy of these ideas, but he could not battle against them. In other respects he appeared quite well; he had been getting stout, and looked in very good health; there was a slight greenish tinge about the skin of the forehead,—he had not noticed it.

242. Examination of the morning urine,—16 ounces, light amber, specific gravity 1·016, acid reaction. After standing twelve hours it is opaque, not from urates; a slight scum has risen to the top, which consists of vibriones and many small crystals resembling spikelets, these latter dissolve in dilute nitric acid; upon taking a drop from the lower stratum of the fluid, the characteristic octohedra of oxalate of lime appear in great quantities,—no other crystals. In two days this urine became ammoniacal, of a yellowish-green colour, and smelled like seaweed, full of vibriones and oxalate of lime.

243. The bowels having been relieved with an

alterative pill, the patient not being habitually costive, a dinner-pill, to be taken daily, a quarter of an hour before that meal, was ordered, composed of two grains of cayenne pepper, two of rhubarb, a third of a grain of ipecacuanha powder, and a little extract of gentian, to stimulate the enervated stomach to an increased flow of gastric juice. An hour after dinner a tablespoonful of cod-liver oil to be taken in half a glass of sherry; to discontinue the use of fermented bread, a poison to the weak stomach, and to take instead either unfermented bread or biscuits; to leave off beer and wine, substituting cold brandy and water,—otherwise, to live well, to take more exercise, and rest for a time from mental labour. Under this treatment the patient steadily improved, the symptoms one by one leaving him: the urine cleared, became acid, and ceased to undergo the ammoniacal fermentation; and in about a month, with no other treatment, the patient regained his usual health, at the same time getting thinner.

Although the treatment in this case was so simple, it was equally efficacious; and I shall endeavour presently to show that it was so, because it exactly suited the wants of the system, and nothing else would have been so effectual.

The next case, from long neglect, was of a more severe character, and probably would have taken a considerably longer time to cure; but I feel morally certain that it would have yielded to correct treatment, and perfect health, bodily and mentally, would have resulted.

244. A gentleman consulted me, suffering severely

from the effects of long-neglected indigestion: he had been a Judge in one of our colonies, and had to travel very long journeys on his circuit, during which time he had very little exercise, but sat all day, either in his carriage or at his duties: he lived well. This mode of life continued for some years, when he began to suffer from indigestion; his liver was sluggish, and he had piles; he became despondent; he did not think he was so successful as he ought to have been, although he was looked up to by all, and was generally liked, as an upright, honourable man, and was nearly "at the top of the tree" in his profession. The idea of suicide at length appeared to him, and he gradually began to entertain a desire to terminate his existence; he was always considered of a melancholy turn, but he now became almost unbearable, and he was advised to leave for England to effect a cure.

245. On seeing him, he began at once to state his desire to commit self-destruction. He said that it was constantly before him, he could think of nothing else, —that everything he did had some connexion with the one all-absorbing idea; if he saw a knife, he considered how best he might succeed in cutting his throat; if a rope, how he might hang himself; if water, how drown himself; and yet, with all this, although he had had many opportunities, and when he had prepared everything, he said to himself, "No! I am not mad; I cannot do it, it would be a sin." On asking him any question, he would answer me with perfect sanity. All his answers were most sensible, and he appeared to have a superior mind;

but he would immediately return to his one idea—suicide. In fact, he was a monomaniac.

246. His skin was of a peculiar colour, a smoky-brown; he had several scabs upon his head which caused him much irritation, and one or two on his hands; he was weak, but pretty stout; he suffered much from flatulence. Upon examining his urine, it was literally crowded with innumerable crystals of oxalate of lime of all sizes; it was acid, and contained a few crystals of uric acid. I told him what he was suffering from, and explained the mode of treatment; but he was guided by his friends, who considered him lunatic, and, in spite of my advice, he was placed under a psychological physician.

247. I have since heard that, not improving at all, he was sent abroad to travel, but that he was no better, and was still travelling. This is one of the many cases that are considered lunatic, where the brain is the organ supposed to be primarily affected, or rather, perhaps, secondarily affected, but too late to do any good by improving the state of the system, the treatment being directed to the mental alienation.

248. The brain suffers less from primary disease than any other organ in the body; it is true it sympathizes with all, and frequently becomes secondarily affected. True insanity, from actual primary disease of the brain itself, is perhaps the most rare disease to which mankind is subject. Almost every form of insanity, arising from disease of other parts of the system, is amenable to treatment. I extract the

following case from Dr. Golding Bird's excellent work on Urinary Deposits, from its bearing out my views on secondary or reflected affection of the brain from primary disease of the ganglionic system, and the circulation of poisoned blood.

"*Intense hypochondriasis; emaciation; copious discharge of crystals of oxalate of lime, with excess of urea.*

"249. On February 15th, 1842, I was consulted by Mr. W. Stone, in the case of a gentleman residing in a densely populated district in this metropolis. He was a remarkably fine man, about thirty years of age, of dark complexion, and whose expression was strongly characteristic of deep melancholy; he was highly educated, and appeared to have painfully susceptible feelings. It appeared from his history, that, until within the last four years, his health had been excellent; at that time he contracted a sore, which was regarded as syphilitic, and so treated with, *inter alia*, abundance of mercury and iodine, which appeared to have aided in bringing on an extremely cachectic condition.

"250. Partially recovering from this, he left England on an Eastern tour. He visited Malaga, Egypt, and returned to England *viâ* Constantinople. At each of these places he underwent treatment for what he regarded as a return of venereal symptoms, apparently only manifested by relaxation of the throat, producing hacking cough. At the latter place he fell under the care of Dr. MacGuffog, who evidently took a very correct view of the case, and he received decided benefit from his treatment. At last, wearied and dispirited, with an irritable throat, bearing about with him what he regarded as a venereal taint, and tired with wandering, he returned to England, a prey to the most abject hypochondriasis.

"251. When I saw him, his naturally expressive countenance indicated despair; he complained bitterly of the inefficacy of medicine, and seemed only in doubt whether he were doomed to die of syphilis or phthisis. The pulse was quick and irritable; tongue morbidly red at the tip and edges, and covered in the centre with a creamy fur. He had lately lost much flesh; he was troubled with a constant hacking cough, which evidently depended on an

enlarged uvula; for on examining the chest, I could not succeed in detecting any evidence of disease.

"252. There was extreme palpitation, increased by eating and by exercise; much flatulent distention of the colon, with pain between the shoulders, across the loins, and over the region of the stomach; extreme restlessness, and nervous excitement accompanied every action. The bowels were inclined to be constipated; urine copious; appetite rather voracious, but unsatisfying; skin acted imperfectly. February 15th, the urine passed last night was acid, pale, of specific gravity 1·0295, contained much mucus, with abundance of flesh-coloured urate of ammonia in suspension. On warming a portion, so as to dissolve the latter, a very copious crystalline deposit of oxalate of lime, in *cuboid* crystals, was rendered beautifully visible by the microscope. A large excess of urea was present, the addition of an equal bulk of nitric acid rendering some of the urine, placed on a watch-glass, nearly solid in ten minutes. The urine passed this morning was precisely similar.

"253. ℞ Acid. nitrici dil.,
Acid. hydrochlor. dil., āā ʒss.
Inf. serpentariæ, ℥xj.
Syr. zinzib., ℥j.
M. capt. ℥j. ter die.

℞ Ext. aloes pur., gr. ij.
Conf. opii., gr. iij.
M. ft. pil. o. n. s.

Allowed a bland nutritious diet, with three glasses of old sherry daily; no vegetables, butter, or sugar.

"254. 27th.—Has continued the treatment up to this date with very marked improvement; his expression is now cheerful; bowels act freely and healthily; pain much less; skin active; throat not so troublesome. Pergat. The night urine was now of lower specific gravity, being 1·020, scarcely containing an excess of urea; a slight deposit of urate of ammonia was present, mixed with a small quantity of oxalate of lime in crystals. The morning urine contained less of the oxalate. He continued this treatment patiently and persistently until March 20th, when he was so much better that he desired a country trip. I discontinued his medicines, and ordered him a mild tonic aperient occasionally.

"255. May 1st.—I again saw this gentleman. He has gained strength, flesh, and spirits; he only complained of occasional headache, and a dread of a return of his ailment, and is anxious to break through his restrictions of diet. The urine now contained no excess of urea, and was nearly free from oxalate of lime. An occasional aperient was ordered for him.

"June 4th.—He again called upon me; he is free from disease, and his most pressing evil seems rather to arise from a lurking dread of phthisis than aught else. The urine is natural."

256. This is an exceedingly interesting case, and shows how, with judicious and careful treatment, a severe form of hypochondriasis, arising from a poisoned state of the blood, may be completely cured, in a very short space of time, and without much difficulty.

Most probably this gentleman had been a free liver; from the amount of urea passed it is evident that he was taking more nitrogen in his food than he was enabled to make use of, and it was of an unhealthy character, rapidly degenerating into oxalic acid.

257. The mind may be affected to a considerable extent by disease which is never even suspected, there being positively no symptoms whatever that the patient can detail, except with the aid of judicious questioning. The following is a case of this description:—

An old lady, upwards of seventy, had been for ten years unsettled in her mind;—she was miserable herself, and made every one about her the same; she had a constant dread of some calamity—what it was she could not state, but some evil appeared to her distorted mental vision always to be impending,—

sometimes it was connected with money matters,—sometimes she feared bad news of a son in India,—sometimes it was her own health she feared would fail.

258. She continued in this state more or less for ten years, when I was consulted for what she termed a blind boil in the back of her neck. Upon examination, a large carbuncle was found slowly forming. I wished to see the condition of the urine, and found, as I had suspected, large quantities of oxalate of lime in faintly acid, and neutral urine. A more generous diet was ordered,—port wine, quinine and iron, and cod-liver oil—with poultices to the carbuncle. Under this treatment, it increased rapidly, was opened, and quickly healed—the urine gradually became natural, and her health and spirits much improved—she took a little exercise, and she lost all the miserable ideas which had hitherto weighed on her mind like an incubus.

259. In this case, the blood, poisoned by the abnormal ingredients contained within it, in circulating through the brain, had given this dark colouring to all the affairs of life; but by degrees a spontaneous cure was projected by nature, in the carbuncle, which, doubtless, if it had been left to itself, would have been a very considerable time in maturing; but, with the assistance of a better diet, stimulants, and tonics, it soon cleared the system of the morbid products, and, as her daughter informed me afterwards, since the carbuncle, she had been more amiable and happy than she had been for ten years.

260. There are many such cases as this—people who pass through life disliked by their acquaintances —unhappy in themselves—feeling and knowing that they are not well, and yet unable to detail any symptoms sufficiently prominent to form an excuse to consult a medical man—and when, if it is done, they are told they are hipped, are hypochondriacal, must take a blue pill and seek amusement—and are frequently driven as a last resource to the advertising quack, who makes a rich harvest by such a patient. It certainly is often most difficult to diagnose these cases, but a careful examination of the urine is most likely to lead to the wished-for result.

261. There are symptoms which accompany urine depositing vibriones—or as it is sometimes designated, caseous or chylous urine—so obscure that it is almost impossible to narrate them: heavy pains in the back and loins not constant; a want of energy, despondency, headache, occasional, slight and very gradual emaciation, tremblings. These might be caused by many other diseases, therefore it is almost out of place to mention them here, except that the affection is so intimately allied to the one previously described, frequently one running into the other, that they can be both classed under the same category, and treated upon the same plan.

262. They both arise from the same cause, varying slightly in different individuals in the precise symptoms and abnormal ingredients passed in the urine. In the Introduction, I have endeavoured to describe some of the chemical changes going on during assim-

ilation. One of these is the metamorphosis of albumen in the tissues, by oxidation, into gelatine, and that again into urea and some complementary ingredient. These changes are carried on in the capillaries, supervised by the sympathetic system of nerves. From some cause—hereditary, miasmatic, magnetic, electrical, syphilitic, or other—the tone of the system is lowered; it is partially paralysed; the effect of which is, that, instead of the normal change of the gelatine into urea, it is converted into oxalic acid and ammonia, or some other abnormal change takes place.

263. In some instances the urea is passed in a weak form, easily undergoing decomposition into oxalic acid and ammonia; and in these cases the symptoms are not so severe as in those where the oxalic acid is produced within the system, and circulates in the blood.

I have frequently examined urine microscopically immediately after it is passed, that has not contained a crystal of oxalate of lime; but upon resting twelve, twenty-four, or thirty hours, has been full of them. Urine crystallizing out oxalate of lime, I have invariably found full of vibriones, and rapidly becoming alkaline.

264. I believe that oxalic acid in this instance is formed at the expense of the urea or uric acid. The formula for

Urea is, $C_2 H_4 N_2 O_2 + \overset{\text{2 at. water.}}{H_2 O_2} = \overset{\text{Oxalic acid.}}{C_2 O_3} + \overset{\text{2 at. ammonia.}}{N_2 H_6} + O;$

Uric acid, $2 (C_5 H_2 N_2 O_3) + H_4 O_4 + O_2 = \overset{\text{2 at. urea.}}{C_4 H_8 N_4 O_4} + \overset{\text{3 at. oxalic acid.}}{C_6 O_9};$

Oxalic acid, $C_2 O_3$.

There must be sufficient ammonia given off to counteract the acids that have been freed from the lime, with which the oxalic acid combines, and to make the urine alkaline. If therefore it is derived from the urea, the urate of ammonia remains unchanged. If from uric acid, the ammonia is set free; and the urea undergoes further changes.

Lehmann states his belief that in very acid urine a portion of the oxalate of lime is held in solution by lactic acid, and advises that the acid should be neutralized, the urine boiled, and allowed to cool slowly before looking for the crystals.

265. The indications for treatment are, to increase the tone of the system,—to improve digestion and assimilation, by stimulating the nerves supervising those functions to increased action,—to improve the condition of the blood, by affording the most healthy ingredients for its formation,—to avoid all articles of diet likely to produce the abnormal ingredients,—to ease the anxiety of the mind, by explaining that the body is in error, and removing every cause of irritation.

266. Dr. Prout considers that oxaluria depends either upon the nonassimilation of oxalic acid taken with the food, or upon the malassimilation of saccharine aliments. Hence sugar and other saccharine substances should be excluded from their diet, also vegetables containing the oxalic acid, rhubarb, sorrel, and some lichens containing half their weight of oxalate of lime. The diet should be very nutritious, but made dishes should be particularly avoided; acid

wines—Madeira, claret, &c.—must be relinquished; but good beer, if not found to disagree, and good port wine, with the same proviso, may be allowed. Exercise must be regular, and a good deal taken; walking, riding, and rowing, hunting and shooting, should be recommended, as they amuse the mind at the same time.

267. Change of scene, when the urine is more healthy, is decidedly beneficial; lively companions are desirable, and every endeavour must be made to avoid the subject upon which the mind of the patient is preying; exhibitions, theatres, music, amusing books, must not be forgotten. The medicine should be tonic: small doses of opium every night; quinine, if the appetite should fail, before meals; the nitro-muriatic acid three times a-day after meals; the sesquichloride of iron occasionally, with the acids; sulphur baths, if the skin should be irritable. If left alone, this form of diathesis relieves itself, as it were, by the appearance of some affection of the skin, carbuncle, psoriasis, &c.; and this sign should not be lost sight of, and increased diaphoresis should be encouraged by baths, &c. In conclusion, I may state that it must be a very obstinate case, and of very long standing, that will not yield to treatment.

ALKALINE URINE.

DEPOSITS,	*Phosphates of Lime, Soda, &c.* *Triple Phosphate of Ammonia and Magnesia.* *Vibriones, Proteine Oxides.* *Mucus, Epithelium, Pus, &c.*

268. Alkaline urine, from a fixed alkali being present, I shall pass over, as of inferior importance, and proceed at once to the more severe affections accompanying ammoniacal urine.

This form of urine, if found to be constantly present, is generally co-existent with an irritative form of dyspepsia; the appetite is capricious; there is a sense of weight and fulness at the præcordia after meals, accompanied by flatulence; the tongue white and shaky, pulse quick and irritable; dull, heavy pain across the loins, sometimes creeping round and down the insides of the thighs, even to the knees; excessive depression of spirits and great despondency, and, to quote the words of Dr. Golding Bird, "In a merchant, surrounded by affluence, visions of impending beggary often embitter the moments that are free from the excitement of business; in the mechanic, unfounded ideas of immediate loss of employment and visions of the interior of a workhouse are generally present."

269. The more severe cases may be classed under two heads—surgical and medical. Of the former, where there is some mechanical injury affecting the cord or bladder, I shall not treat, confining myself to the latter. Alkaline ammoniacal urine is pathogno-

monic of severe depression of the nervous system; it accompanies dementia, melancholia, and mania; it is found in some cases of long-continued seminal discharges, and in hectic, and, except in cystitis, is a bad symptom. In the latter disease the urine becomes ammoniacal, from the morbid mucus and epithelium cast off by the mucous membrane of that organ, rapidly setting up fermentation in the urea, which is converted into carbonate of ammonia, the urine as passed from the kidney being perhaps normal.

270. The class of patients most likely to consult a medical man for this affection are over-worked literary men, especially those who have been careless of their strength, have lived freely, and, taking advantage of their younger days, have called too liberally upon their genius, and overtaxed their brains. Half the ills of middle life are caused by the constant calls upon the strength during youth. A young man knows not fatigue, but daily and hourly injures some portion of his system, which, although repaired immediately, and not observed, will in after life, as certain as he lives, cause him fearfully to rue the time he threw away his strength upon that which gave him but little pleasure then, and produces years of future anguish.

271. The symptoms accompanying alkaline ammoniacal urine are most deplorable, not to mention the severe pains attendant upon indigestion, the pains in the loins, hips, thighs, and knees; the headache, dizziness, loss of sight, singing in the ears, palpitations, and flutterings; the melancholy, the dread, the horrible

ideas (frequently leading to suicide) which pervade the mind of the sufferer, are hardly to be described except by those who have experienced them.

272. The treatment is straightforward, and in most cases, if thoroughly carried out, effectual. The stomach, which is always in fault, requires stimulating; it does not secrete sufficient, or normal, gastric juice, to counteract the fermentation set up in the proteine compounds; an immense quantity of gas is consequently evolved, consisting mainly of nitrogen, which should be fixed as one of the ingredients of albumen required for the process of assimilation.

273. The gases in the stomach have been estimated by M. Chevreuil as oxygen 11, carbonic acid 14, hydrogen 3·55, nitrogen 71·45, in 100 parts. Much nitrogen is wasted, and the urea passed by the kidneys is of so weak a form as to become converted into carbonate of ammonia before it is passed, if even it be not secreted as such. All articles of diet readily undergoing fermentation should therefore be avoided, and the very worst of these is bread; bread, as made now (whether it is the German yeast, I cannot say), rapidly ferments in the stomach, giving off much gas; it must be avoided, and unfermented bread made use of instead.

274. The best antiferment is the bisulphate of lime discovered by Melseus of Brussels; it may be given in small doses after meals; if given carefully it does not arrest digestion,—merely the morbid fermentation. It is, however, seldom needed. Strychnia with hydrochloric acid, and a little cod-liver oil,

about half an hour after a meal, has the same effect, and is more beneficial.

275. The urine being alkaline, mineral acids are indicated: the nitro-muriatic is the best; it soon affects the urine, at the same time it stimulates the sluggish liver, so that the secretions are improved. Quinine does not always agree; it should be tried, however, for when it does, it aids the cure very materially. Opium, in small doses, allays irritation and acts as a tonic; it seldom increases the costiveness usually accompanying this diathesis. The bowels may be kept gently stimulated with small doses of rhubarb, the best aperient in all cases of indigestion, especially where strychnia is being administered at the same time.

276. The diet should be light, but very nutritious, as food is required to repair the exhausted tissues, especially the nervous: small quantities frequently repeated are found to be most beneficial; oysters, eggs, milk, cream if not too rich,—in fact, anything that the stomach will bear; cold brandy-and-water, or Allsopp's pale ale in bottle; most beers do not agree, rapidly fermenting—the Indian ales are the best. Regular exercise, gradually increased; the relinquishment of all mental labour; agreeable company and amusement,—in fact, a complete change of mental occupation, resting the brain as much as possible; sleep is indispensable, and if not to be attained otherwise, must be compelled by opium; other means, however, should have been first resorted to.

Case.

277. I was called in to attend a young lady, aged fifteen, who was subject to very peculiar symptoms. She would be suddenly seized with cramp in the fingers and forearms, and would stand or sit with her hands and arms stretched out in a most helpless manner. There was tenderness referred to the spine about the seventh cervical vertebra; her urine was occasionally, just before and during these attacks, ammoniacal, throwing down crystals of the ammoniaco-magnesian-phosphate. An emetic always instantly removed the cramps. Her health was not very good; and although she improved under an alterative and tonic form of treatment, it was thought advisable she should be removed into the country, and I have since lost sight of her.

278. Alkaline ammoniacal urine in this case appeared only during the times of the attack, and she seemed perfectly well, both in health and spirits, at other times, except perhaps being a little delicate. She was particularly backward in her studies, unable to learn anything: her brain, as regards the acquirement of knowledge, was void. Quinine was of great utility, staving off the attacks whilst it was taken; but there appeared a general want of tonicity of the whole cerebro-spinal system, which required fresh country air and the fostering care of parents.

Case.

279. A gentleman who had been a great *roué*, had run through an ample fortune, and, as usual, had

been dropped by his *friends*. He was reduced to great extremity, and with all the tastes and inclination to expensive and luxurious living, was frequently forced to go without a meal. He became much depressed in his mind, and lived in the most wretched manner. He had removed himself into the greatest obscurity, and was slowly dying from depression of nervous energy. He was discovered by some neighbours, and I was sent for. I found him thoroughly prostrate in mind and body, a prey to the most horrible ideas of a future judgment, and resembled mentally a man with delirium tremens, except that he had not the physical symptoms of that disease.

280. His water threw down clouds of mucus and epithelium, with crystals of triple phosphate, and rapidly became putrescent; doubtless there was much urea, but I did not examine for its presence. He improved under the use of opium, quinine, and iron, and the moderate use of stimulants; his urine became more natural, but, catching cold, he was attacked with pneumonia, and rapidly sank.

281. In these severe cases of depression, opium is our sheet-anchor; it calms the excited mind, lends tone to the system, and is the foundation on which to build our treatment. I have known a patient who had been given up by many able physicians—Dr. Golding Bird among the number—be kept alive for two years upon opium; it was her food, her life, her everything. She had suffered from long-standing disease of the ovary, which had progressed beyond the power of medicine to cure. It was merely a case

of life or death: the fiat was death, but she lived two years on opium.

282. The judicious use of strychnia in these cases of great nervous depression is found to be very beneficial; it should not be carried too far, but may be combined with other tonics. Given at bedtime with a little rhubarb, when costive, it will be found greatly to assist the purgative, and will produce a motion where the most powerful drastics would fail.

The nitro-muriatic acid is of advantage in keeping the phosphates in solution, and preventing the formation of calculi; and where they are forming, or where the bladder is much affected and very irritable, ten minims of the dilute acid, with half a drachm of tincture of opium in barley-water, may be injected into the bladder daily for a short time.

Case.

283. A clergyman may come to us, complaining of a series of obscure symptoms, for which he can obtain no relief. He complains chiefly of a peculiar kind of indigestion an hour or two after meals; he suffers from a severe pain in his chest, extending all over it through to the back and about the heart, which frequently flutters, stopping for a beat, then hurrying on six or eight beats, very much frightening him. The pain is relieved by taking food, but it comes on again afterwards; alkalis, which he has been recommended to take, give him no ease; he rather thinks acids are better for him, as, if he takes

them, they dispel a quantity of wind, and he feels more easy.

284. He suffers from headache, especially when moving his eyes about from side to side; sometimes when he rises from his writing he is so dizzy he can hardly stand. "Yes, he writes, and has a good deal of head-work. No, he is not married. He has noticed his water very thick; it throws down a sort of powder, and there is a scum on the top—has noticed it for some time—thought it was connected with the indigestion; he has pains in his loins and a weight about the bladder—is costive."

285. This gentleman's case is common among clergymen, authors, barristers, &c., men who have much head-work, but little bodily exercise. The cure, if the malady has not lasted very long, is easy; but if it has become a confirmed habit is by no means so, and may take some time, although the treatment is simple, and may be easily carried out.

286. If the urine should be alkaline when passed, the ejaculatory ducts may become irritable, and seminal fluid may be discharged with it. This form of seminal emission does not require local treatment by cauterization, if it is caused merely by the irritable condition of the bladder and urine, but abates as the urine becomes healthier; but sometimes the constant irritation produces a chronic inflammation of the ejaculatory ducts, and a slight cauterization is required; it is, however, amenable to treatment.

287. The tincture of the sesquichloride of iron, in half-drachm doses, seldom fails to arrest any slight

irritability of the ejaculatory ducts, or of the bladder, which occasionally, through the contact of the morbid urine, becomes irritable, requiring the patient to pass water more often than natural, and sometimes inducing painful spasm.

The following case, extracted from Dr. Golding Bird's work on *Urinary Deposits*, points out the peculiarities of the diathesis as found in the labouring man, affecting more the body than the mind, that organ not having been overworked in his case.

Case.

288. G—— L——, aged eighteen, admitted into Luke's Ward, under Dr. Golding Bird, April 9th, 1845, a native of Bristol, and employed at an iron factory; has always lived temperately, and his health previous to the present illness has been good, being merely the subject of occasional attacks of indigestion, with flatulent eructations. Four years ago vomiting came on suddenly, after an ordinary meal, accompanied by severe pains at the pit of the stomach, to which, in a less severe form, he had been subject during the previous year. With occasional, but rare intermissions, this vomiting recurred daily after every meal for six months, being preceded by intense pain, relieved on emptying the stomach. It became less frequent for the following eight months, occurring but once or twice a-day, but never losing it for twenty-four hours at a time.

289. He then became a patient at the Bristol Infirmary, and underwent a great variety of treatment, with the general result of obtaining partial relief, but never losing his daily paroxysms of pain and vomiting. On admission into Guy's Hospital, the lad's complexion was pale and bloodless, with a slight icteric tint; emaciation most extreme; his bones were barely covered, and his face was so extraordinarily emaciated, that it rather resembled a skull over which parchment had been drawn than anything else. His general appearance was that of a person in the last stage of schirrus of the pylorus.

290. He complained of burning heat at the scrobiculus cordis, and heavy pain across the loins; tongue, clean and red; pulse, quick and sharp; skin, dry and imperspirable. He vomits a short time after every meal, and declares that he has not passed a single day during four years without vomiting three or four times. There is great thirst; bowels act daily, with frequent eructations possessing an odour of stale fish. Urine loaded with the triple phosphate and alkaline, with a disgusting fishy odour, even when first passed, sp. gr. 1·020, not albuminous. No tumour can be felt at the scrobiculus cordis, where there is some tenderness on pressure; the abdomen distended with flatus.

291. April 9th.—Vomited near four pints of thin, acid, yeast-like matter.

℞ Misturæ magnesiæ, ℥j. ter die.
Milk diet.

11th.—Vomited daily after dinner. The vomited matter presented the same yeast-like appearance. Urine has an ammoniacal odour, and deposited phosphates copiously.

℞ Strychniæ, gr. j.
Acid. Nitrici dil. ʒj.
Aquæ, ℥xij.
Solve, et capiat æger. ℥j. ter in die.

He was strictly confined to milk diet; the medicine to be taken fifteen minutes before each meal.

292. 14th.—Vomited yesterday before dinner, and again after tea, and after breakfast this morning.—P.

15th.—Vomited last night, but not since; has passed thirty ounces of urine in the preceding twenty-four hours, copiously depositing phosphates; appetite good; begs for a continuance of the medicine, stating that it keeps his food down; abdomen not so flatulent.

16th.—In no pain; vomited last night at seven o'clock, with rather more than usual pain; urine, alkaline; forty ounces in twenty-four hours, and full of prismatic triple phosphates.

℞ Olei tiglii, ʒj.
Lin. saponis, ʒvij.
M. ft. linimentum scrobiculo cordis bis die illinendum, et pergat.
Fish diet.

293. 19th.—Not vomited since the morning of the 17th; the liniment has brought out a crop of pustules; has felt no pain since the vomiting has ceased; urine neutral, containing but little deposit; complains of great thirst.—P.

22nd.—For the last two nights his skin has acted freely; urine free from deposit, sp. gr. 1·014; troublesome flatulent eructations.—P. From this report, the same treatment being continued, the patient improved, the vomiting ceased, and the urine became acid. He had recovered his good looks, and became decidedly fat in his face.

294. On May 19th, he suffered a slight relapse after paroxysms of pain in the left kidney, followed by vomiting and the discharge of urine loaded with phosphates, and becoming alkaline soon after emission. This was but a transient attack; he soon recovered, and left the hospital apparently quite well.

May 31st.—This patient appeared among the out-patients, apparently pretty well; he had suffered one relapse since leaving the hospital, after a copious meal of tripe. The urine was, however, not quite healthy, and contained some phosphates.

295. I remember a very parallel case to this, which I attended, and which had been brought on by drink. The man was a groom, subject to the vicissitudes of the weather, and had been accustomed to warm his inside with frequent libations; the stomach had become very irritable, with constant eructations, and pains from flatus extending through the abdomen, loins, hips, and thighs. He had vomited regularly every day about five in the afternoon, four hours after his dinner, for many months; and he was gradually getting worse and the pains more intense; he rapidly improved on leaving off the spirits, taking cod-liver oil twice a day after meals, and eating unfermented bread.

296. In conclusion, I may say that these cases, if seen early, are very amenable to correct treatment,

and that one invaluable aid is electro-magnetism, or the galvanic bath; for the nervous system being so much lowered in tone, the stimulus of electricity lends for the time that which it is unable to produce for itself—nerve force; and during the time of its administration, by medicines, diet, and regimen, the health is gradually invigorated and brought up to the normal standard. However, there are cases where the disease appears to have taken such a firm hold of the nervous system, that although the symptoms may be alleviated for a time, upon any indiscretion they return with increased virulence, eventually carrying off the patient.

URINE, *Acid or Neutral,—Pale, of a muddy greenish colour, occasionally containing Albumen.*

DEPOSITS,
- *Casts of urinary tubules.*
- *Epithelium from the kidneys.*
- *Epithelium from the bladder.*
- *Pus-corpuscles.*
- *Blood-cells.*
- *Oil-globules.*
- *Vibriones.*
- *Oxalate of Lime.*

297. Of the acute forms of Bright's disease, it is not my province to speak, neither shall I refer to the complications with anasarca and dropsy, but to a slow, lingering form, sapping the brain or the body of its energy, producing fatuity, insanity, and pre-

mature old age,—a disease requiring years to produce any positive symptoms, and those of so obscure a form, that the kidneys generally remain unsuspected to the last.

298. Through the researches of Dr. Bright and others, we learn that the kidneys undergo a peculiar degeneration,—the epithelium of the tubules become gradually overloaded with fat, so that they fill the tubules with their bulk, thereby producing congestion; this congestion gradually spreads, and the kidney is less able to perform its proper functions—the elimination of urea, salts, &c. The origin of this disease is some peculiar cachexia, generally connected, however remotely, with the scrofulous diathesis.

299. From insufficient vitalization in the formation of fibrine, there is a tendency to the production of fat or oil, which seeks elimination at the various glands, where the debris of healthy fibrine are accustomed to be excreted,—namely, at the lungs, liver, and kidneys. In the disease under consideration, the kidneys are the organs sought out by the effete and degenerated fibrine, and the mal-effects produced I shall now endeavour to describe.

300. After a lengthened and slow marasmus, which, from its gradual onset, has not been sufficiently cared for by the patient or his friends, accompanied by costiveness, diarrhœa, indigestion, flatulence, headaches, nervous irritability, and other obscure symptoms, which have appeared, and disappeared again frequently; generally there is a pale, waxy, etiolated aspect of the skin. The patient has a fit:

this arouses the fears of all, and a medical man is sent for, who may discover the following pathognomonic appearances in the urine, if he examines it:—

301. The urine is passed in quantities equal to what would be passed in health, of a pale, muddy, greenish colour, slightly opaque; specific gravity, 1012 to 1004 according to Dr. Christison. I have never seen it so low: about 1008 is the average. Upon testing for albumen by nitric acid and heat, it is found sometimes to be present, sometimes not; it is, however, no criterion. Upon rubbing the cork upon the slide (as directed in paragraph 171) and examining with a quarter object-glass, numerous small casts of tubules, somewhat resembling portions of hair, will be seen, containing in their interior granular matter, with oil-globules, or sometimes so dark as to resemble masses of pigment: epithelium scales from the kidney containing oil-drops, and numerous pus-cells, with perhaps a few blood-corpuscles, accompany them.

302. Upon the discovery of these there can be no mistake in the disease. I have examined urine that has displayed all these *débris*, which, upon testing with nitric acid and heat, has not indicated the presence of albumen. It is in the earlier stages, if the patient has the good fortune to have his urine examined, that albumen is found. If we test for urea, we shall find a great deficiency in that important excretion; but if the blood be examined, there it will be found: the system is therefore poisoned by the presence of that which in health is daily and

constantly eliminated, the kidneys having gradually and slowly failed in their duties, until the system is unable to bear up against the effects of the poison circulating in the blood: the fit is the consequence, expressing the protest of the nervous system to the mode of nutrition.

303. This is one effect of the disease; there is, however, another, which I have seen in two cases, and which I believe to be more common than is generally suspected. Instead of the fit being the first warning symptom, the patient's mind is found to be weakened. He takes notice of the most trivial and absurd things; he will descant for a considerable time upon the manner in which the breakfast things are laid, taking umbrage at the fork being on the wrong side of his plate, and continually returning to this ridiculous trouble, perhaps for a whole day. I was told of a gentleman who was exceedingly prolix upon the method of putting out a candle. "He was always accustomed to use snuffers himself, but some made use of an extinguisher," &c., *ad nauseam*.

304. The same gentleman was exceedingly irate with his wife, even to striking her, because she had dined without him, she having waited an hour, he being only in the adjoining room and continually sent for. The brain in this form of disease appears to be weakened to fatuity, never aroused to madness, although irritability about trifles is a constant symptom.

305. The mode of treatment indicated is tonic, slightly or rather indirectly diuretic, and diaphoretic.

Cod-liver oil is a remedy that should be commenced immediately, and steadily persevered with through the whole treatment. Liquor ammoniæ, or the aromatic spirits of ammonia, may be advantageously combined with it. If there is diarrhœa, it should be checked by degrees, as it is an endeavour to eliminate by the bowels that which the kidneys are unable to get rid of. Opium, as Dover's powder, at night, is the best mode of administration. If costive, the compound jalap powder is a good aperient, and may be given continually with benefit.

306. Diaphoresis is necessary; the vapour or hot-air bath is the most convenient method of inducing it; two or three times a week, not carried sufficiently far to have a lowering effect. Other tonics, to suit the case, may be combined, as the ammonio-citrate of iron, or the citrate of quinine and iron, or some combination of iodine with iron may be found useful. They must, however, be given with caution, as in many forms of scrofulous disease I have seen the worst effects produced by their indiscriminate use.

307. I should expect the greatest benefit from the steady use of cod-liver oil, with a nutritious, but unstimulating diet, a moderate quantity of diluent drinks, a steady action on the skin, with warm clothing, and the avoidance of draughts and all exposure to changes of temperature. Extraneous symptoms must be treated as they arise, and a judicious and firm control held over the weakened brain, so as not to allow the absurdities of the patient

to remain uncorrected. Tears are easily induced in such cases.

308. If you should be consulted before the more severe symptoms should have appeared, upon inquiry the patient tells you that "he has not been quite the thing for years, but he has never been particularly ill; he has been to doctors, who have recommended him change of air and scene; these he has tried, generally with benefit. But he is getting worse; he feels very unsettled in his mind; he has pains in his head, but they are not very bad; occasional dizziness and loss of sight, but they go off; he sleeps more than he used to; he makes mistakes in his business; can't remember things; breaks important appointments; goes out, intending to do something, but comes home, having forgotten it; is more irritable in his temper; captious and angry without cause; suffers from indigestion, and very much from wind,—in fact, thinks he is going out of his mind. There is nothing the matter with his water that he is aware of: no; it's his head. If you can only put that to rights, he would be well enough."

309. I remember three cases, which occurred many years ago in my father's practice, which will serve to illustrate the manner in which the same disease will produce very different trains of symptoms in different individuals. There were three brothers, the sons of an exceedingly hearty old gentleman, who, I believe, is still alive: the mother died of some asthmatic affection. The eldest son, after suffering some considerable time from disease of the heart, accom-

panied with great difficulty of breathing, died, and upon a post-mortem examination extensive disease of the kidneys was found. He had probably passed albuminous urine for years before the secondary affection of the heart had been produced, for which he sought advice. The disease of the kidneys was, during life, overlooked.

310. The second brother lingered for years, dropsical, his legs full of fluid, a martyr to dyspnœa. The case was recognised as one of albuminuria, and he was long kept alive: he is now dead. The third brother, after showing great eccentricities, became insane, and was removed to an asylum. This third case, although not diagnosed as the effects of degeneration of the kidneys, with retained urea, was, I have no doubt, a modification of the same disease of which his brothers had died. I consider these to be most instructive cases, from which much may be learnt. I am only sorry that notes were not taken at the time, and that pathology was not as well studied, and the knowledge derived from it as broadly spread, as it is now.

Case.

311. A gentleman, aged thirty, pale, emaciated, with the face drawn and eyes prominent, had for some time been noticed by his friends to be very peculiar; in his business he was constantly making the most stupid mistakes, so much so that all his transactions had to be watched, and he was at length advised by the firm to retire for a time to recruit his

health. In his domestic arrangements he was equally foolish, taking, and having upon his hands, no less than three houses at the same time, buying horses for which he had no use, and many other such proceedings.

312. To his servants he was peremptory, flying into passions at the most trivial excuse; very nice in the order of his table, noticing the least divergence from his rules. As he was very weak, he objected to sleeping with his wife, and had a bed made for him upon the ground floor. He eventually became occasionally and partially paralysed, now and then losing the use of his legs, which he would regain after a short time. This gentleman was under the care of a City surgeon; but I was allowed to examine his urine, as I had heard of the case, and was desirous of discovering the cause of these peculiar symptoms.

313. The urine contained no albumen recognizable by nitric acid or heat; but by the aid of the microscope numerous casts of tubules, pus-cells, epithelium scales, and a few blood-corpuscles, were displayed. I had no hesitation in diagnosing extensive disease in the kidneys. This gentleman eventually died, and at the post-mortem there was no disease of the brain or cord discovered. This is all I could ascertain. I believe the kidneys were not examined, as the surgeon in attendance would not believe they were diseased.

314. Where the urea is retained in the blood, the kidneys failing to remove it, the brain symptoms occur early, and withdraw the attention of the patient, his friends, and the medical observer himself, from

the kidneys to the brain. The method of examining the urine for urea, as recommended by Dr. Edmund Davy, will now be found very useful. Some blood may be removed for experiment, and may be examined for urea, after the formula employed by Simon; this however, is too intricate for use in general practice; I do not, therefore, transcribe it.

315. From many cases which have fallen within my own knowledge before I had turned my attention to the great importance of the examination of the urine in all nervous complaints, I am assured that insanity, in many of its forms, is the result of undiscovered and neglected bodily disease, which, if the urine had been carefully and skilfully examined, would have been diagnosed, and the patient might have been rescued from a madhouse. The brain in many such cases is the first organ to sympathize with the malassimilation and excretion of albumen which is going on in the wonderful chemical laboratory of the human body. The reason for this may be understood, when we consider the immense strain which the brain daily undergoes in these days of hyper-civilization, when every man has to toil almost beyond his powers to keep himself and family in that station to which he or they consider themselves entitled.

316. The brain is the organ on which all labour rests; muscles have lost their value since the days of steam, and the inventing and governing power is all that is required. The brain, if the blood be impure, is the first to discover it, and a change is noticed in the temper or feelings of the individual. This state

gradually and slowly advances, until insanity is the result. Or, on the other hand, although the blood may be equally impure, yet it may produce no effect upon the brain to be detected by others, until some great shock occurs—misfortune, joy, or otherwise, which the already enfeebled organ is unable to resist, and insanity is the consequence.

317. The brain is at the present day overtaxed; the muscular system not sufficiently so. Insanity is on the increase, active inflammation on the decrease. It is therefore of the greatest importance to all who suffer from indigestion and obscure nervous complaints, and who have any great mental strain, to beware, and whilst there is yet time, to resort to remedies, and have the blood purified. The cure, if commenced early, is generally simple, and depends, in a great measure, on a more correct diet, and increased bodily exercise, together with alterative and tonic medicines.

URINE,—*Pale, turbid, of a greenish colour, containing sometimes albumen, sometimes sugar; great quantities passed.*

DEPOSITS,
- *Vibriones.*
- *Fermentation globules.*
- *Penicilium glaucum.*
- *Sugar fungus.*

318. From urine having the characteristics described above, we learn that the patient is suffering from

a disease affecting the sympathetic nervous system of the capillaries, supervising digestion, assimilation, and secretion. The pathology of the disease has not yet been fully made out; but it appears to be the result of a peculiar conjunction of circumstances not frequently occurring; for it is a rare disease—frequently a fatal one. Although the urine is our chief guide in the detection of diabetes, yet the kidneys do not appear to be so much in fault as other organs superintending blood production and destruction—the liver and lungs are more affected than the kidneys. In fact, diabetes is essentially a nervous affection, the ganglionic system being partially paralysed.

319. I shall now mention the symptoms as described by Dr. Watson:—"Uneasiness in the stomach after meals, flatulence and acid eructations, dimness of vision, redness of the whole interior of the mouth, sponginess of the gums, looseness of the teeth, and some degree of irritation and inflammatory redness about the external orifice of the urethra; these last are symptoms noticed in persons dying of inanition. Again, listlessness and depression of spirits, weakness and peevishness of temper:" "the once vigorous mind becomes feeble, oblivious, and vacillating; the once amiable temper fretful, suspicious, and intolerant." "With all this, there is a peculiar faint odour of the breath and person; an odour which Dr. Prout says is hay-like, which some call melleous, but which reminds me of the smell of a room in which apples have been kept."

320. "Diabetes is generally a chronic disorder,"

"and may be very insidious in its course; the patient may suffer for years from it without being detected. It is essentially a disease of debility, and should be treated on the tonic plan. When we consider the amount of waste to the system caused by a drain of ten pints of urine per diem, at the average specific gravity of 1040," "we need not be surprised at the hunger, the great thirst, the wasting, the hectic fever, the feeling of emptiness and sinking at the stomach, the debility, the chilly state of the body, and especially of the extremities, the aching and sense of weariness in the loins and legs, the aversion to exercise, the loss of virility; all of which symptoms are generally present."

321. "The skin is dry and harsh, with a burning sensation to the feel; the bowels are costive, hard, and lumpy. The tongue is dry and parched, sometimes like a raw beef-steak,—in fact, the patient is very ill; and he will generally tell you that it has lasted some time, and that he can get no relief." Schönlein states that there is no sugar in the urine in the first stages of the disease, but albumen, and as the albumen disappears, sugar appears. This is difficult to disprove, as the disease is seldom seen in its earliest stages. However, grape sugar is formed in the system, and is discovered in the urine with the aid of the microscope, by the presence of the fungi peculiar to sugar fermentation, and by various chemical tests.

322. The difference between cane sugar, and diabetic or grape sugar, must be fully understood before entering into the theory of the disease. Cane sugar

is converted into grape sugar by the addition of an acid. Grape sugar, diabetic, and other animal sugars, such as that found in the liver, in milk, &c., are not affected by dilute acids, but they are converted into brown acids by a concentrated solution of an alkali at a high temperature:—

Formula for cane sugar . . . $C_{24}\ H_{22}\ O_{22}$;
Formula for grape sugar . . . $C_{24}\ H_{28}\ O_{28}$.

Cane sugar, therefore, is converted into grape sugar by combining with six more equivalents of water, and this is affected by the addition of an acid.

323. Grape sugar is formed from—

Starch . . . . $C_{24}\ H_{20}\ O_{20}$

by the action of saliva. Grape sugar can be formed also from fats, from the proteine compounds, by first becoming glycocoll, and then grape sugar; and this may take place in any portion of the capillary system. From the investigations of Bernard, Handfield Jones, and many other observers, it has been clearly proved that sugar is formed in the liver during health, and that without any materials derived from the blood, but from its own tissues, the parenchyma containing abundance of sugar. Mr. M'Gregor declares that in diabetes sugar is produced in the stomach, meat only having been taken. It is probable also that sugar is extensively produced in the circulation.

324. During the first quarter of an hour, or more, after a meal, especially where the digestion is weak, the food, if regurgitated, will be found to have a

sweetish taste; the contents of the stomach, however, soon afterwards become acid. It appears, then, that the production of sugar, both in the stomach and liver, is a healthy function: the sugar in the stomach undergoes a further change, either into a fatty principle, a proteine, or an acid; and this is effected by the vital or nervous energy of that organ. The sugar of the liver is passed as such into the hepatic vein, where it may be detected in large quantities; it is then carried on to the lungs; but there is none found in the aorta (in health). In the lungs, therefore, it undergoes a change; this I suppose to be into acetic acid, by yielding up an equivalent of hydrogen and nitrogen.

Glycocoll . . $C_4\ H_5\ NO_4 + O = C_4\ H_4\ O_4 + HO + N.$
Grape sugar . $C_{24}\ H_{28}\ O_{28} = 6\ (C_4\ H_4\ O_4) + 4HO.$

325. In diabetes, the change of sugar in the stomach and lungs into other principles does not take place, but from want of power is absorbed as such, and being an abnormal ingredient in the circulation, is removed by the kidneys, together with a large quantity of water. This, then, is the theory of the disease, and it has been supposed by some that there is a ganglionic centre in the brain which supervises this sugar change, which, to a certain extent, is borne out by experiments upon animals, and also (as has been shown by Dr. Goolden in, I believe, two cases) where saccharine urine has been induced in men by blows upon the head.

326. Now what is the treatment indicated by the symptoms of the disease and the theory I have laid down?

First, by artificial means, to convert the sugar in the stomach into principles of a fatty, proteine, or acid nature, as should take place in health; this can be effected by the administration, about twenty minutes after each meal, of pepsine or rennet, to supply the place of the gastric juice, which appears to be in a great extent wanting; then, by not giving much starchy aliment, and nothing to create fermentation —as yeast in bread, beers, fruity wines, &c.—much of the sugar production is avoided. This method has stood the test of experience, and has been found beneficial by several observers.

327. Fat, as I have shown, is one of the most important of the alimentary ingredients, and is peculiarly so in diabetes. Firstly, it fixes the nitrogen in the stomach, much of which otherwise would be wasted; secondly, by its presence the change of starchy matters into fat is not required; and, thirdly, under a fatty diet no sugar is produced by the liver, as has been shown by Bernard. Of course, no patient could live on fat alone, but a large quantity should be taken, both as materials of the diet, and as cod-liver oil soon after each meal; at the same time brandy-and-water should be taken to afford a temporary stimulus to digestion.

328. And here again galvanism is most useful, and should be applied immediately after each meal to the hypochondria. Interrupted shocks and a large quantity should be made use of, and of only sufficient tension to penetrate through the parietes; moist conductors are therefore necessary. I can confidently

recommend galvanism for improving the digestive powers, as I have repeatedly found the benefit of it in maldigestion. I therefore place it amongst the remedies for diabetes.

329. Opium, as a tonic, in small regularly-repeated doses, to be given through the whole treatment of the case, is almost a specific in all chronic diseases of a low type. I do not think that quinine is of advantage in diabetes, certainly not in the early stages, and yet it might be supposed that it would be, for Sydenham says—" Sometimes (though rarely) it happens that old men, who have had ague, and have been bled and purged improperly, become diabetic, even after the fever has wholly departed. This is because their blood is so far weakened as to be incompetent to the assimilation of the juices of the ingesta, so that these seek an outlet in a crude and unconcocted form by the urinary ducts. Then the excessive loss of urine weakens the frame, and the whole substance of the body passes off by this channel. In this affection, as in all sorts of diabetes, no matter how originating, the curative indications must be wholly directed towards restoring and invigorating the blood, and so restraining the preternatural flow of urine."

330. Like all the observations of this great physician, there is much to be learnt from this,—first, as to its being a sequela of ague; secondly, as to the crudity of the blood from loss of digestive powers; and, thirdly, the indications for treatment.

From being a sequela of ague, it would be imagined that quinine would be beneficial, but I have tried

it in the early stages and have found no benefit from its use. When the patient is recovering—when the fever is removed, the skin acting freely, and the kidneys pouring out less water—then quinine assists the cure.

331. The vapour-bath acting powerfully upon the skin, increases, or rather stimulates a large flow of perspiration; by this means the kidneys are relieved, and consequently the lumbar pains. I cannot better describe the benefit to be derived from the vapour-bath than by transcribing the declaration of a patient of Dr. Watson, who had been relieved by its use, before leaving the Middlesex Hospital:—" The urine is reduced more than one half, and does not contain much sweetness, but sometimes tastes salt with a mixture of bitter. My stools, which were dry and like balls packed together, are now quite natural. The pains in my limbs are entirely removed. My spirits, which were very much depressed, are now revived and cheerful. The unpleasant aching of my kidneys, of which I spoke little, lest I should be cupped in the loins, is now removed; only I feel weak there. I am cured of the pain in my stomach, and the circuitous working of the wind in my bowels, which formed lumps in my belly as it passed, resembling those formed by the cramp. I have likewise got rid of the palpitation of my breast (heart?) which was accompanied with a sort of dread. My breathing is much improved; perspiration in a great measure restored; and my skin, which was dry, is now become moist. I sleep well at night, whereas

I could not sleep more than two or three hours out of the twenty-four. My thirst, which was excessive, has ceased to be troublesome."

332. This speaks admirably for the vapour-bath, and there is no doubt it is a most powerful aid in our treatment, as it is the most potent of the diaphoretics; it must be made use of daily, and the heat should be gradually increased until perspiration is induced, the lower the temperature the more advantage derived. The tincture of the sesquichloride of iron has a specific effect upon the urinary organs; it checks secretion, and lends tone to the relaxed solids; it may be given in large doses, thirty or forty minims, three times a-day, in a little infusion of quassia.

333. If the vapour-bath is not sufficient to keep the bowels gently acted upon, once a-day or twice in three days, provided the patient is not an enormous eater (which should not be allowed,) a pill containing two grains of rhubarb, two of dilute aloes, and one-fifteenth of a grain of strychnia may be taken once, twice, or thrice a-day at meals, according as they may be required.

334. I trust I have not overloaded with medicines and treatment this disease; but it is a fatal one, and unless care be taken, it will most surely kill, either as diabetes, or by developing some other fatal disorder, as phthisis pulmonalis. Again:—A person who has once suffered from diabetes is always liable to a return of the disorder, and should be careful of placing himself in a situation whereby the powers of the

system may be lowered, especially from a severe chill, which would arrest the secretion from the skin.

335. Dr. Handfield Jones has made some interesting experiments in reference to the amount of sugar secreted by the liver upon different diets. "The subject of the first was a young dog, who was fed for six days on bread and meat. The quantity of sugar contained in his liver, as determined by fermentation, was 20·13 grains per 1000. The second, a young kitten, was fed for six days on food as far as possible of the saccharine kind—rice, sugar, arrowroot, and potatoes. This disordered her bowels after some days; but by leaving off the rice, and confining her to potatoes chiefly, she recovered her health. Her liver contained 31·66 grains of sugar per 1000. Hence the saccharine diet produced fully one-third more sugar than the albuminous."

336. There is no doubt that by decreasing the amount of starchy and other saccharine aliment, the sugar passed by the kidneys is decreased in quantity *for a time;* but it has no effect upon the disease, except perhaps a bad one, for the liver forms sugar out of albumen; and, according to Mr. M'Gregor, the stomach has the same power; so that organs which would easily form sugar from starch, &c., appear now to be forced to form it from materials requiring more labour to effect that change, for in diabetes there is an increased sugar-secreting tendency in the nervous system. Therefore the diet should be principally animal, with fats; the vegetables should be cabbage, spinach, &c.; *no bread*, but biscuits instead;

no beer or wine, but brandy-and-water; no sugar or raw fruits. As there is great thirst, when sufficient fluid has been taken, and more desired, the patient should be allowed to gargle his mouth and fauces with water acidulated with a mineral acid; this usually allays thirst for a time.

URINE,—*Natural, or otherwise.*

DEPOSITS, { *Any of the preceding.* / *Spermatozoa.* }

337. We are constantly meeting with cases that have been bandied about from doctor to doctor, from physician to surgeon, and back again, and then fall, as the last resource, into the hands of the empiric. These cases are the opprobrium of our profession, and do us much harm, for by them a set of harpies are kept in affluence, whereas many of our brethren exist on a mere dole. To urge their correct diagnosis, and point out a rational mode of treatment, would, I am sure, be a boon to the great body of the profession; although, with a tenacity which is most difficult to account for, our eyes are shut, even our hands are placed over them, to keep from our view an affection which consigns hundreds—aye, thousands—to a life of misery and early death; which blasts the fame of many a man, by perverting his reason, and is a fruitful source of suicide.

338. In my own case, which may be also that of others, I was never taught at the hospitals which I attended, either theoretically or practically, that in-

voluntary seminal discharges arose from morbid change. I had never read of them in books—*i.e.*, in the ordinary works on medicine and surgery. I had never seen a case treated, either in private practice or at the hospitals; and when such a case was talked of, it was pooh-poohed, and looked upon as chimerical. As a young man and student, I believed as I was taught; but upon entering into practice for myself, I learnt differently; in fact, cases were thrust upon me with evidence so glaring, that I must have been wilfully blind, after having studied them, not to have been convinced of their actual presence.

339. Oddly enough, without seeking them, I have had several very interesting cases of this description under my care, sufficient to enable me confidently to express my opinions upon their pathology and treatment; and if I can, by the evidence brought forward and the conclusions drawn from it, convince some few of the general practitioners in medicine, as well as physicians, of the verity of such a disease, I shall have done some good,—not to science, because the disease is fully recognised by authors, but to the profession. To disarm criticism, I must here record that I *know* many physicians and other members of our profession who do not acknowledge ulceration of the ejaculatory ducts, and degeneration of the prostate, amongst the affections to which man is heir; or if they do, have not the slightest idea how to treat them.

340. A sufficient number of cases have not been within my reach to make a thorough system; I have not, therefore, classified them, but shall wait until

further knowledge and observation shall give me greater ability to do so.

Case.

A young man, handsome, well-made, apparently in splendid health, came from one of our colonies to be cured of stammering, to which he had been subject, more or less, all his life, but lately had been getting worse; he was also suffering from other obscure symptoms, night-sweats, indigestion, and costiveness being amongst their number.

341. He was advised to try several physicians, one after the other, which he did, without relief. He was then told that if he could be cured of his stammering he would get well. He therefore went to Mr. Hunt, and was in his house, I believe, six months; at the end of that time he was certainly worse than when he came to England. This young man was a personal friend of mine, and having met him on several occasions during the course of his treatment, and from many conversations with him, I was quite sure that there was something the matter with him beyond mere stammering; in fact, I came to the conclusion that this was the effect, and that the cause was as yet undiscovered.

342. I suspected some disease of the genito-urinary tract, and asked him if he had ever had his urine examined. He said not. I therefore invited him to my house, when I would give my best attention to the case. He came. There was no albumen or sugar in the urine; but upon examining it microscopically,

I found several spermatozoa. Eventually, I obtained from him the following history:—

343. Age 25, of a healthy appearance upon casual inspection, large build, inclined to stoutness, five feet ten inches high, weighs 153lbs.; has been accustomed to much horse-exercise, hunting, shooting, &c., and is fond of field sports. He is a merchant at one of our colonies—lives in the country—is a stammerer—has been so all his life, more or less, but is now worse than ever; at one time, when about fifteen, he could speak pretty well, but has now got so bad that he can hardly articulate one single word without making the most painful efforts.

344. As a child, and even to the time when he was at school, he was accustomed nightly to wet his bed, thus shadowing forth a weakness of the prostate. He was of very excitable temperament; he had connexion very young, and soon acquired some form of venereal disease; he was afraid to place himself in the hands of the regular practitioner, and consulted a quack, who kept him more or less under the effects of mercury for more than a year, in which time he was salivated two or three times;—in the hands of the regular practitioner, whom he at last consulted, he was again salivated, and then underwent a long course of sarsaparilla, iodide of potassium, copaiba, cubebs, *cum multis aliis;* since which time he has been costive, and has always passed some discharge from the urethra after going to stool.

345. He now complains of great weakness and lassitude, loss of spirits and of memory, is unable to

connect his ideas, is quite unable to remember anything he reads, occasionally fancies he is going mad—has sometimes fits of the greatest misery, when he has no desire to live, life being a blank, there being no future to a stammerer; he is fond of communicating his ideas, which he is now quite unable to do,—shuns society, for he feels no pleasure in it,—does not expect ever to get cured, but will try anything.

346. Complains of a sensation of weakness in the groins, pelvis, and back, as also occasional pain in the right epididymis, which is slightly enlarged; has frequently a sense of wetness in the urethra, although nothing passes; has twitchings of the eyelids, occasional startings of the tendons, and the limbs frequently tremble, without apparent cause; the muscles are quite flabby, and he is unable to walk half a mile without extreme fatigue, pains, and wetness in the urethra. Pulse 65, irregular, very weak, of moderate volume.

347. His chest is peculiarly formed, having a depression and thinning of the lower part of the sternum, where he complains of tenderness on pressure; the breathing is hurried, especially during conversation, when it is irregular, and frequently spasmodic, the diaphragm contracting rapidly two or three times in succession. Tongue quite clean and healthy; has a very large appetite, but finds that wine and spirits do not agree with him; does not smoke; suffers from indigestion and costiveness. The fæces solid, light-coloured, and with a depression upon the upper surface flattening them out. His urine becomes ammoniacal soon after passing, and a pellicle of phos-

phate of lime rises to the surface; he has been subject to this description of urine for a considerable time.

348. The skin over the neck, chest, and abdomen is covered with a light bronzed appearance, which he has noticed for years, but it is less since he has been in England. Last winter he had on two mustard poultices, the situations of which are marked by a uniform bronzed colour, darker than the other patches. He thinks that this bronzing is connected with the perspirations from which he has suffered, as they are found only under the flannel. He has wetted his night-clothes and sheets two or three times in a night, so as to have them changed, the perspirations have been so excessive.

349. Will bring me some of the discharge on a slide—about a drachm, lumpy, having all the appearance of semen. Under the microscope, innumerable spermatozoa, with epithelium scales and mucus cells; in the clearer fluid there are a few circular masses of carbonate of lime, from the prostate. This discharge he always passes upon going to stool, but thinks nothing of it, as he has had it so long; and the doctors have always told him it was merely a little weakness, which would go away when he got stronger. Go away? Why, it was draining his life from him—the very essence of his blood passing daily from him like so much mucus. This young man must have died, probably in a lunatic asylum, if his malady had not been discovered.

350. Such is one case that I have known go the round of the doctors, and which would have even-

tually fallen into the hands of the advertisers in our papers. Is this right? Why should he be told by one that he is hypochondriacal, and that he should try and amuse himself, to keep his brain from constantly brooding upon his malady? Why should another tell him that it was merely indigestion, and that he would recover if he took some of the pil. aloes, dil., which he did, and which did him no good, but the reverse. Why should Mr. Hunt tell him that he did not get better because he did not apply himself to his rules? Because they were either ignorant or wilfully blind to the real cause of the disease.

351. It would occupy too much space to recount the treatment of this case from the commencement to its termination; sufficient to say, that he has lately called upon me, in perfect health, and during the course of an hour's conversation he did not hesitate or stammer once. It is now his intention shortly to leave for home, confident in his ability to battle with his impediment, his malady having been cured.

352. To be better able to understand this affection —*the involuntary discharge of semen*—I must enter (as briefly as possible) into the anatomy of the parts, the physiological phenomena connected with the secretion, the storing and the emission of this wonderful fluid, and the pathological changes resulting from disease.

353. THE URETHRA

Is a canal which passes from the neck of the bladder to the meatus urinarius; it is lined with mucous membrane continuous with that of the bladder, vasa

deferentia, prostatic ducts, Cowper's glands, and various small mucous glands, in its course. It is about nine inches in length in the adult, but varies considerably. It may be divided into the prostatic, membranous, and spongy portion. Beneath the mucous membrane, mixed with the fibrous layer, smooth muscles are found, both longitudinal and circular, through its whole length.

354. Mr. Hancock, in his *Anatomy and Physiology of the Urethra*, states that the muscular fibres of the membranous portion of the urethra are continued over the inner and outer surface of the prostate into the muscular coat of the bladder, so that there is one continuous muscular coat from the bladder to the termination of the canal. The epithelium of the urethra is cylindrical, beneath which is a layer of oval cells. Many small glands secreting mucus are found in the urethra: they, as well as their excretory ducts, are lined with cylindrical epithelium. The epithelium of the bladder is of the laminated form, the deeper layer being conical or cylindrical; the more superficial, rounded, polygonal, or more or less flattened. The cells exhibit a great want of uniformity in size and shape.

355. THE PROSTATE

Is situated in front of the neck of the bladder, resting upon the rectum, through which it may be felt with the finger. It surrounds the urethra for rather more than an inch of its length, a third of its bulk being placed above, and two-thirds below the canal. It

may be divided into three lobes—two lateral, and a middle lobe situated between the urethra and ejaculatory ducts. The prostate is principally a muscular organ; the smooth fibres are seen to run immediately beneath the mucous membrane, mixed with elastic fibres and connective tissue, to the trigonum vesicæ, unconnected with the proper muscles of the bladder; surrounding these is a strong layer of circular fibres, termed the sphincter prostatæ.

356. Beneath these are found the glandular cells of the organ, which consist of numerous pedunculate glandular vesicles. The whole body is invested with a tough, fibrous coat, abounding in bundles of organic muscular fibres; this dips inwards, dividing and closely investing the glandular lobules. The secretion of the prostate is a clear, rather viscid fluid, containing a proteine compound, which may be drawn out in threads; it is discharged into the urethra by about twenty excretory ducts, situated on either side of a fold of mucous membrane, which may be termed the prostatic valve.

357. The prostatic portion of the urethra is very dilatable, but, excepting during the passage of urine, is completely closed by the sphincter prostatæ, the prostatic valve being pressed upwards; but during micturition, the two delicate tendons which pass from the posterior fibres of the detrusor muscle especially draw it down. Beneath the mucous membrane of the prostatic portion of the urethra is found a rich plexus of veins, and the whole organ is freely supplied with blood. At the anterior extremity of the pro-

static valve are found the mouths of the two ejaculatory ducts; these lead within the substance of the prostate, beneath the middle lobe, to the vesiculæ seminales.

358. THE EJACULATORY DUCTS

Are composed of a delicate membrane, consisting of elastic tissue, smooth muscular fibres and connective tissue, lined with cylindrical epithelium; they gradually widen into

(359.) THE VESICULÆ SEMINALES,

Mere prolongations, or rather appendages, of the vasa deferentia: their walls are more delicate. Externally, the vesiculæ are invested with a membrane, in part composed solely of connective tissue, in part, as on the posterior surface, muscular, which is continued between the separate convolutions of its canal, connecting them together, and at the base of the prostate passes from one to the other as a broad muscular band. The vesiculæ seminales secrete a clear, rather viscid fluid, containing a proteine compound soluble in acetic acid.

360. Besides this secretion, the vesiculæ contain spermatozoa: they may, therefore, be considered to act as receptacles for the semen, when secreted, until required. They are situated between the ureter and vas deferens of either side, at the base of the bladder, converging towards the base of the prostate: they lie upon the rectum just beyond the prostate, and are

about two inches long. They are well supplied with blood, and have large plexuses of veins.

361. THE VASA DEFERENTIA

Are cylindrical canals, composed externally of a thin fibrous membrane, in the middle of a strong smooth muscular layer, and internally lined by mucous membrane; they pass from the vesiculæ seminales at the posterior border of the cord, behind the arteries, veins, lymphatics, and nerves of the testis, and enter the epididymis. They shorten and contract upon stimulus after death with remarkable energy.

362. THE TESTES

Are true glands: each is contained in a firm fibrous sheath, the tunica albuginea, which gives off processes dividing the testes into lobules. Each lobule is composed of a long convoluted tube, which may be unravelled. At the smaller end of each lobule the spermatic tubule straightens, and several join to form one tube, which, together with others, compose the rete testis. At the upper end, efferent canals are given off, which, piercing the tunica albuginea, are continued into the epididymis, where they are very much convoluted, forming its head; from here the duct of the epididymis is formed, and convoluted to a great degree, forming its body and tail—the origin of the vas deferens. The epididymis is covered with an extremely delicate fibrous tunic.

363. The seminiferous tubes of the testes, in boys, contain minute clear cells, but at the age of puberty these cells enlarge, and are found to contain one or more interior cells; each, as it increases, may be observed to contain a spermatic filament in the form of a spiral corpuscle with two or three turns (Kölliker). About the rete testes these cells burst, discharging the true spermatic filaments, spermatozoa.

364. The semen, as found in the vas deferens, is whitish, viscid, and inodorous, consisting almost entirely of spermatozoa. The ejaculated semen is a mixture of this pure semen and of the secretions of the vesiculæ seminales, prostate, Cowper's, and other glands of the urethra. In this condition it is opalescent, with an alkaline reaction and characteristic odour.

365. THE SPERMATOZOA (See Fig. 24)

Are homogeneous, of an opalescent appearance: each consists of a flattened oval, or wedged-shaped head, and a long tapering tail; the head, when seen upon its back, is oval, sometimes nearly round, but when upon the side, wedge-shaped; the tail in a fully formed filament is from twelve to fifteen times the length of the head, and the head is about the 1-7800th of an inch in length. I have frequently observed spermatozoa with an enlargement of the tail immediately below the head, even in perfectly healthy semen. What this portends I do not know, only it is not uncommon.

366. Besides the spermatozoa there are the so-called spermatic granules: these very much resemble the mucus cell, only they are of very different sizes, some

being more than twice their size, others smaller; frequently one may be seen to burst, and a spermatic filament escape; the vermiform, or, rather kicking movement, immediately commences, the head being protruded, a part of the tail still being coiled within the cell: the filament struggles to free itself, kicking, as it were, the cell from it.

367. Kölliker, Gerber, and others, describe cysts containing many filaments, packed closely together in apposition: these I have never seen in the ejaculated semen; probably they discharge their contents before emission. The semen in the vas deferens differs from that discharged, it being in the former situation pure, consisting of spermatozoa and spermatic granules floating in a white viscid fluid; in the latter case it is mixed with the secretions of the vesiculæ seminales, prostate, and Cowper's glands, and is opalescent and viscid. Soon after it is passed it melts down into a watery fluid. Berzelius considers this is owing to spermatine, which exists suspended in the semen, but when passed is dissolved, and is not then coagulable by heat.

368. Upon evaporation, semen is found to contain many crystals of the triple phosphate of ammonia and magnesia; the spermatozoa resist destruction most remarkably, and may be found in healthy urine and other animal fluids for a considerable time after secretion. Very acid, or much diluted urine, causes the motions to cease; but upon the addition of a more viscid fluid, such as syrup, motion will again commence.

369. Nitric acid will dissolve them; so also do caustic potash and soda after some time; they contain a large per-centage of phosphate of lime. Vauquelin's analysis of semen—

Extractive (spermatine?) 6; Phosphate of lime, 3; soda, 1; water, 90.

In old neglected cases of seminal discharges, the spermatozoa are imperfect, and easily break up into heads and tails. The heads separating as rounded granules.

370. *The Supply of Blood*

To the organs of generation is copious, and is returned by veins forming large plexuses which pass from the testes within the cords to the inferior vena cava and renal vein; and from the penis beneath the mucous membrane of the prostatic portion of the urethra, surrounding the vesiculæ seminales, to enter the internal iliac vein: they are bound to the bladder by a layer of aponeurosis.

371. *The Nerves*

Are derived from the sympathetic, and from the lumbar, sacral, and hypogastric plexuses.

Physiology of the Generative Act in the Male.

372. Seminal fluid is first secreted between fourteen and fifteen years of age; at this time the sexual organs undergo an increased development, and a much larger supply of blood is sent to the parts. The nervous system participates, and an increased

desire to the opposite sex is the consequence. If the mind should be directed towards objects which will excite sexual desires, the nervous influence is directed to the parts, a larger supply of blood flows there, and increased secretion is the consequence. The presence of seminal fluid in the vesiculæ seminales, on the other hand, excites the brain, so that the action is complementary—the brain, by desire, excites secretion; the secretion excites the brain; coition calms both for a time.

373. If connexion does not take place too frequently, and when it is followed by renewed vigour; when the head feels cleared, the body endowed with more tone; when a greater disposition to exercise or mental labour is experienced, we may consider that the individual has been benefited by the coitus, and the semen may be considered as an excretion. But how is it that in perfect health, when removed from the power of gratification, as on board ship, this secretion is not discharged? True, occasional spontaneous emissions take place, but very rarely, and not to be compared with the accustomed amount emitted on shore.

374. In animals, seminal fluid is only secreted at the period of heat; and so it is with man; semen is secreted slowly, it passes into the vas deferens, and so on to the vesiculæ seminales; here it is, if the secretion continues, stored up. If the brain should be excited by sexual desire, secretion immediately is set up, and continues as long as the excitement lasts, and a great quantity of semen in the young man

may be secreted; but if the excitement ceases the secretion ceases.

375. In large towns, where there are so many stimulants to sexual excitement, the mind may be kept in a continual state of desire, by being turned towards the object: a morbid excitement is set up, which produces secretion, perhaps without any emission following, laying the foundation of disease.

376. Dr. Carpenter truly observes—"The sexual secretions are strongly influenced by the condition of the mind. When it is frequently and strongly directed towards objects of passion, these secretions are increased in amount to a degree which may cause them to be a most injurious drain on the powers of the system. On the other hand, the active employment of the mental powers on other subjects has a tendency to render less active, or even to check altogether, the processes by which they are elaborated. This is a simple physiological fact, but of high moral application. The author would say to those of his younger readers, who urge the wants of nature as an excuse for the illicit gratification of the sexual passion,—Try the effect of close mental application to some of those ennobling pursuits to which your profession introduces you, in combination with vigorous bodily exercise, before you assert that the appetite is unrestrainable, and act upon that assertion. Nothing tends so much to increase the desire as the continued direction of the mind towards the objects of its gratification."

377. Erection is produced by the filling of the

corpora cavernosa et spongiosa with blood; ejaculation is a purely reflex action, over which the will has but very slight control, if any. Naturally, it is produced by friction applied to the glans penis; the stimulus transmitted to the spinal cord is reflected to the various muscles surrounding the vasa deferentia, vesiculæ seminales, prostate, &c.; these act from below upwards; thus the vasa deferentia shorten and contract, pressing the semen into the vesiculæ seminales; these contract upon their contents, pressing the semen and the secretion of the vesiculæ into the urethra, the prostate contracting, squeezing out its secretion to mix with the rest: here the whole set of urethral muscles forcibly contract from below upwards, and expel the semen.

378. If, however, the vesiculæ are not filled with semen, the emission does not take place for some time, the reflexion of the stimulus being concentrated upon the vasa deferentia, which pump up the freshly-secreted semen, until there is sufficient in the vesiculæ to stimulate them to contraction.

379. Although the sensations accompanying these complicated actions are delightful, yet we frequently see in disease, that the whole process may be gone through without producing any sensation of a pleasurable kind; this is when the muscular contractions are hardly called into play: there is an atonic state of the parts, and the secretions, as it were, run away.

380. When we consider the vast importance of the generative system to man,—when we look upon the effects produced by the conjunction of the sexes in

the propagation of the species,—we cannot be too careful of the normal condition of these functions; for not only do we shorten our own lives by allowing them to become deranged, but our inoffensive offspring are condemned, perhaps, to an existence of misery through our malpractices or carelessness.

381. Dr. Carpenter, in his *Physiology*, has drawn attention to these facts in very expressive words. "It may be stated as a general law, prevailing equally in the vegetable and animal kingdoms, that the development of the individual, and the reproduction of the species, stand in an inverse ratio to each other. In many organized beings the death of the parent is necessary to the production of a new generation; and even in numerous species of insects it follows very speedily upon the sexual intercourse. It is a curious fact, that insects which usually die—the male almost immediately after copulation, and the female very soon after the deposition of the eggs—may be kept alive for many weeks, or even months, by simply preventing the copulation. And there can be no doubt that, in the human race, early death is by no means an unfrequent result of the excessive or premature employment of the genital organs; and where this does not produce an immediately fatal result, it lays the foundation of future debility, that contributes to produce many forms of disease to which there may be a constitutional predisposition, especially those of a scrofulous nature."

382. I disagree with Dr. Carpenter in considering that the scrofulous is the most probable form of

disease to be dreaded by over-excitement of the generative system; but all classes of nervous affections are to be feared: in childhood, stammering, chorea, epilepsy, and general marasmus; in youth, timidity, obscure pains, particularly in the loins, groins, and thighs, a want of power of the brain to concentrate upon any particular subject, a dread of some indefinite trouble, misanthropy, and epilepsy; in manhood, obscure affections of the heart or liver, fatty degeneration of vessels or organs, paralysis, impotence, and insanity.

383. I place these affections to the age in which they are most likely to appear, although those which I have mentioned as peculiar to manhood may occur earlier. Feuchtersleben, in his *Medical Psychology*, fully allows, as a frequent cause of insanity, morbid excitement of the generative system; he even goes so far as to say, that the repression of the sexual desires will cause many forms of nervous disorders, and that many of the anomalous symptoms observed in young women arise from the sexual desires being ungratified.

384. To quote his words:—"Still greater, and perhaps the most active of all physical influences on mental life, is the influence of the sexual function, effected through the medium of the generative focus, and manifesting itself chiefly at the periods of development and change of life, and in the difference of the sexes. Schiller, therefore, with reference to these two influences, was, perhaps, justified in saying of nature, that till the influence of the spirit shall govern the fabric of the world, it is held together by 'hunger and love.'

385. "From the very first period of sexual life we observe, that with the retarded development of its organs and functions there is more tardy development of the mental activity, and with the more rapid formation of the former, a more active development of the latter. Whether the development of the cerebellum, as is generally supposed, is proportional to these relations, seems to be at present problematical. Many facts are in favour of the supposition. Baron Larrey saw the genitals disappear on an injury of the cerebellum. Others against it; such as the cessation of the instinct when the organs are injured, and a comparison of the instinct with the cerebellum of animals."

386. With reference to the desire departing upon the loss of power to gratify it,—this is no objection to the theory, as nature in a state of health is too good a judge, and too careful of the organism, to stimulate a desire in the brain which the body is unable to gratify. Also the system of nerves which supply the genitals are in such "*rapport*" with the cerebellum, that the stimulus from the former not being transferred, as usual, to the latter, the desire dies away, except the cerebrum is implicated, by memory of old lascivious desires, which may be called into play by the eye, fancy, memory, &c.; then the stimulus is created by the cerebrum and not by the cerebellum.

387. But to continue with Feuchtersleben's observations:—"The psychical metamorphosis, which takes place with puberty itself, is too great to escape the

notice of the most careless observer. The mind of the young man is powerfully impelled in the direction of the will, that of the maiden in the direction of the feelings; images of undefined delight float before their minds; the enchantress, Fancy, reigns in all her loveliness; soothing and rapturous emotions alternate in a constant tumult of ecstacy; and love as a passion, with flattering but despotic hand (fortunate those who are able calmly to guide it), seizes the sceptre.

388. "When happily controlled, whether designedly, through education and self-reflection, or undesignedly, by an harmonious proportion of the desires in the natural disposition, love becomes the source of the most beautiful psychical developments; and he who never loved is or will become egotistical, mean, narrow-minded, covetous, timid, and but too often an unnatural sensualist. If ill directed, this terrible passion becomes a source of the most deplorable sufferings.

389. "The act of coition itself has a most decidedly psychical effect. If exercised with moderation, at full maturity, and at the right moment, it leaves (notwithstanding the 'omne animal post coitum, triste') a pleasurable feeling; nay, it invigorates the powers of thought, as is shown by the example of the ingenious voluptuary Casanova, who at such moments solved the most difficult mathematical problems. If not gratified when urgent desire exists, it may indeed occasion psychical uneasiness, and especially distract the attention; but as the corporeal ill consequences of

abstinence have always been estimated much too highly, so also a cultivated understanding and a vigorous will, will not have psychically much to suffer from them.

390. "If inordinately indulged it leaves, through the exhaustion of the nervous power, a sensation of mental depression, and, if too often repeated, total debility of every mental power. Intellectual dulness, melancholy, and weariness of life, are the least of the ills produced by it." "Morbid conditions of the sexual activity have as decided an influence on the mind as their physiological state.

391. "Retarded or impeded development contributes to the melancholy of chlorotic girls; licentious voluptuaries are mentally dull and egotistical; all their powers of thought are devoted to sexual ideas; the enervated are melancholy, pusillanimous, misanthropical, and weary of life. Those, on the other hand, who are totally abstinent are inaccessible to softer sensations."

392. All these evils arise either from unnatural sexual excitement or from excess in indulgence. If used moderately, and when naturally excited by love and by desire, then not only no evil arises, but the system is actually benefited—a load appears to be taken from the mind, and the spirits are enlivened and invigorated. This is proved also by the opposite sex in the married state—a woman may continue child-bearing for the natural period, and live a long and healthy life afterwards. I know an old lady at this present moment, ninety-two years of age, who

has all her faculties, enjoys life, and has given birth to twenty children. Nature has not willed that our animal instincts should be a curse to us, but we suffer when they are not kept within bounds. It is the case with all our appetites: when enjoyed with moderation, they are beneficial; when carried to excess, they turn round in judgment upon us.

393. Unzer, in his work on the *Nervous System*, speaks "of the instinct for the propagation of the species. By the pre-ordination of nature, with a view to the continuation of the species, there arises in animals an agreeable external sensation—the sensational instinct for propagation—the sentient actions of which are manifested by remarkably active vital movements; and this arises at a time when the organism is in the most suitable state, at a certain age, during a fixed period of existence, for the most part periodically, in the sexual organs given by nature for this express object, by means of natural inducements prepared beforehand.

394. "These depend on a plethoric state, nutritious food, wine, condiments, much rest, idleness, good living, freedom from care, and various external sensations, and other conceptions. In man—who, as regard his instincts, is subject to the same laws as brutes—this sensational stimulus is induced by a glance, an imagination, a foreseeing, which surprises him, without his desire, or even against it, and he terms this operation, which amazes him, the enchantment of love.

395. "He is so little informed as to the design of nature in this wondrous emotion, that at first he

considers it to be the feeling of friendship or of great esteem; in short, to be a noble instinct, not arising from sensual stimuli, until at last he learns, from its influence on the sexual organs, that it tends to an object not observed by him—the excitement of the flesh, and that it is the instinct for sexual congress, to which all the stimuli converge.

396. "In both sexes the instinct consists in the desire to enjoy this sensual pleasure in the greatest degree, which takes place in coitus. Consequently, just as sexual congress is the design of nature in this instinct, so is it also its object in animals, which know nothing more of the ulterior object—namely, the propagation of the species. The sentient actions of the obscure foreseeing of an agreeable external sensation are manifested imperfectly as they actually occur, and in the effort of the animal-sentient forces to attain to these imperfect movements consist the sentient actions of the instinct itself.

397. "The instinct acts, consequently, in the mechanical machines which have to accomplish sexual congress (namely, the organs of generation), since it stimulates them to their appropriate functions, and in particular is developed fully the satisfaction of the instinct—namely, sexual congress. Hence we understand why in this instinct the organs of generation fall into the same state as in coitus, that state being induced according to the laws of the sentient actions, of sensational instincts. These incomplete movements becoming complete in the satisfaction of this instinct, in accordance with the designs of nature, other phe-

nomena having reference to the propagation of the species result, as impregnation, conception," &c.

398. From this it appears that Unzer considers that the desire for sexual gratification first appears at the time of puberty. Now this is entirely a mistake; it is quite impossible to state when this first arises, but it is at a very early age, differing in degree in different individuals. In many children the desire is very strong, but the mode of gratification is unknown; when by chance, or from example, the mode is discovered, and masturbation is the consequence.

399. I may here state that those children who wet their beds are peculiarly prone to this habit; from some irritation about the prostate or neck of the bladder (which I believe to be congenital, and more generally hereditary), the more extensive irritation of the genital organs is propagated. Masturbation in the very young produces a shock to the nervous system; this shock, if repeated often, unsettles the normal action of the nerves; various slight changes occur, although they may not be noticed, the memory may fail, the hitherto bright boy may get a little dull; this change is noticed and wondered at, but cannot be accounted for; indigestion, loss of desire for food, a complaint of a dull heavy pain in the head, a darkness around the eyes, a sallowness of complexion, may all appear one after the other.

400. These continued shocks act primarily upon the cerebellum, for the nervous ganglia of the organs of generation are in close connexion with that portion of the brain. Romberg, in his *Diseases of the*

Nervous System, mentions the following experiment:—"By a lucky coincidence I made the gratifying observation that, in an old cat, whose testicles lay in the abdominal cavity, these organs immediately after death moved whenever the cerebellum was irritated. The effect was such, that whenever the right lobe of the cerebellum and the right half of the vermiform process was irritated, movement of the left testis ensued, and the reverse. Mere superficial irritation sufficed to produce this result, the movement of the testicles soon became so palpable in this animal that there could be no doubt of its reality.

401. "I hastened to open the entire skull and the abdominal cavity, and found the testicles lying perfectly still without any trace of movement. On irritating one side of the cerebellum, the testicle of the opposite side swelled, quitted its position, and rose up so as to form a right angle with the spermatic cord, one side of the angle being directed forwards. If I desisted from the irritation, the testicle returned to its position, and the movement was renewed on renewing the irritation. The experiment was repeated for half an hour with unvarying results.

402. "Alternately with the cerebellum, I irritated the cerebrum, the corpora quadrigemina, the thalami optici, the corpora striata, but I have never seen the slightest movement result from the irritation of these parts. In the vas deferens the movements were alternately those of elevation and depression, an entire portion being distended and collapsing. In the tes-

ticle a general tumefaction of the organ was observed, although I also saw depressions form here and there." Volkmann in one case saw the penis violently agitated.

403. We thus see the intimate connexion between the cerebellum and the various muscular actions of the generative organs; but we do not see the minute shades of reflex action, the thought transferred to the organ, or the slightest irritation of the part transferred to the brain, whereby ideas are called into existence over which we have no control, and which arise from a stimulus far from the brain, but transmitted to it by the nervous system, and are referred to it, rather than to the part.

404. We may easily understand, therefore, that a series of powerful shocks to the delicate nervous centres of the generative system, particularly when they are produced abnormally, will in time affect the brain in a very serious manner; and that a brain which is forming, and which is daily receiving new ideas, and storing them up, may be induced to fix and hoard up a train of observations which may affect the after-life of that child in a very great degree.

405. I have been particular in dwelling upon the effects of masturbation in the child rather than in the youth, because it proves that the injury does not arise solely from the drain upon the system of the seminal fluid, but from the shocks to the delicate nervous centres, injuring them and impairing their functions. One frequent result, proving the injury to the brain, produced, is stammering. Vocalization and articulation are the result of a most complicated

system of muscles, and consequently nerves, the combinations of which to produce each particular sound and word are almost infinite. The correct combinations of these movements are supervised by the cerebellum, and most probably, in stammering, the cerebellum is the organ which is chiefly affected; for there is evidently a want of proper association in the different attempts made by a stammerer to speak.

406. Thus, he endeavours to articulate without having filled his lungs beforehand, and consequently fails to produce any sound; again, he over-vocalizes, by pumping his lungs full of air without having any word to use, and in his haste to say something he breaks down altogether. From my conversations with stammerers, it is evident to me that the affection is the result of the inability to correctly combine vocalization with articulation, as also the different sets of muscles required to produce the various sounds, which, properly combined, result in speech.

407. The cerebellum being the portion of the brain which supervises these combinations, it is easy to understand how the constant abnormal irritation produced by masturbation may interfere with its healthy function, and stammering be induced. This, however, is no hypothesis; for I am informed by a patient who had been in an establishment for the cure of stammering, that almost all the youths who were there for treatment were given to this habit, and that in all cases of spermatorrhœa the affection of the speech remained intractable until the disease which had given origin to it had been previously cured.

408. The spinal cord is also a centre to which many of the movements called forth in the exercise of the sexual functions are referred: there are many reflex actions entirely dependent upon it; but it is more to the state of tension in which certain portions of the cord are thrown, than to the condition of the whole cord, that the state of exhaustion into which the nervous system falls after coitus may be referred.

409. Certain centres draw towards themselves the nerve force from all sides, and by induction produce a high state of tension in it, which, when transmitted to the muscular tract, and to the semen itself (for I believe that an immense amount of nerve force is expended upon the semen, correlating at the time into some other force), become exhausted, and only gradually regain by fresh nerve force being generated in the sympathetic system, and collected by the centres, that state of tension enabling a renewed act of coitus to be accomplished. In diseases of the cord, or rather the lower portion of it, the power to consummate is lost, although the desire is not.

410. THE PATHOLOGY

Of the diseases of the prostate and vesiculæ seminales is not at present very ample. I have extracted the greater part of the following from Rokitansky's splendid work:—

The testes may be atrophied from exhausting diseases, from gonorrhœal neuralgia, from metastasis

of inflammation of the salivary glands (mumps), from the continued use of iodide of potassium, by enlarged herniæ pressing upon their vessels, by exhausting spermatic discharges, and by morbid growths.

The testes, one or both, may not descend into the scrotum, but may be arrested either in the pelvis or in the course of the cord, producing apparent inguinal hernia.

Chronic inflammation of the testis generally produces induration and permanent enlargement.

The epididymis is also subject to chronic inflammation, producing induration and enlargement.

411. The vas deferens suffers from disease, extending to it from the testicle, or vesicula seminalis; its coats are indurated and thickened.

The vesiculæ seminales and ductus ejaculatorii become dilated from continued catarrhal irritation accompanying spontaneous discharges of semen.

Instead of the orifices of the ejaculatory ducts being little nipple-like processes, they sometimes present a chinked appearance, large enough to admit a goose-quill, with erosion of the sphincter surrounding it. Ulceration may proceed from this to the mucous membrane of the urethra, which presents a villous alveolar, and generally inflamed appearance, sometimes yellowish.

412. Chronic catarrh, tumefaction, and relaxation of the mucous membrane, secretion of a greyish or yellow purulent mucus (blennorrhœa), dilatation, and finally thickening of the parietes, occur, or rather are discovered, chiefly in advanced age, accompanying

mechanical hyperæmia of the pelvic veins, the formation of phlebolithes (Hasse, in his *Pathological Anatomy*, enters at some length upon the enlargement of the veins around the prostate and the formation of phlebolithes); also, as an effect of chronic vesical catarrh, of repeated gonorrhœal catarrh of the urethra and neck of the bladder, of excessive venery, and especially as a result of masturbation. A low state of irritation is developed in a similar manner in the cellulo-fibrous substratum of the vesiculæ, which induces condensation and hypertrophy, causing its adhesion to the vesiculæ seminales, which thus become fixed.

Ossification of the vesiculæ and vasa is occasionally found.

413. THE PROSTATE.

Hypertrophy of this organ in the young man is usually found in the lateral lobes, and there is not that difficulty in passing water as in the enlarged prostate of old age, where the middle lobe is so enormously hypertrophied. In some cases the muscular tissue of the prostate appears to have undergone fatty degeneration, and almost to have lost the power of contracting upon the ejaculatory ducts. The prostate not unfrequently is found to contain minute calculi, resembling fine sand or poppy-seeds, rarely attaining the size of hemp-seed or peas; these present a blackish-brown colour, are very hard, and generally glossy; their number is often considerable. The gland is juicy, and the ducts more or less dilated;

these frequently give rise to very severe pain, and may be detected by passing a sound, with a very nice touch, along the prostatic urethra.

414. These are the marks left by the disease, which are discovered after death. But how are we to detect the grievous injury to the nervous system? who is to point out the atrophied nerve ganglia, the injury to the nervous centres, the effects of which are noticed in life, and which doubtless leave their impression upon the delicate nerve globules,—but who is to detect them? Histology has not advanced to that perfection to enable us to do this; but doubtless the day will arrive when the pathology of insanity, and other diseases affecting the nervous system, will be as well known as that of a mucous membrâne is now.

415. THE TREATMENT

May be considered under the two heads of general and local; the first directed to the improvement of the health and tone of the body; the second to whatever lesions may be discovered to be present; besides soothing the mind, which is generally in a low and depressed condition, suspicious, and despairing. To make use of the words of Lallemand:—" How much glory has been lost, how many a noble career has been blighted, how many an unexpected suicide, and how many a fit of despair would cease to be an impenetrable mystery to families and medical men, did we more fully understand the influence of excessive fatigue of the brain on the production of involuntary seminal

emissions, and that still more powerful action of those enervating evacuations reacting on the cerebral functions."

416. Besides dividing the treatment, the class of cases may be also separated into two,—the hereditary and the induced. In the great majority of the cases that have fallen in my way, I have been able to trace a decided hereditary tendency to weakness of the prostate and adjacent parts, and I have been enabled (I trust) to ward off, in children who have shown signs of this weakness (by supplying increased tone to the parts), the advent of the disease in after-life. I do not think I can do better than arrange the cases and treatment of prostatic paralysis in the order of the age in which they occur.

417. A youth, aged eleven, son of Indian parents, precocious bodily, but very backward mentally, was kept from school to be cured of a nightly habit of wetting his bed; he appeared to be well in health, but he occasionally suffered from headache. Upon questioning him and his attendant, I found that he was very shy, hesitated in his speech, was very lazy, preferred lolling about to any active exercise, and was in a weakly muscular condition. He had frequent desire to pass his water.

418. The treatment for this case was a cold bath immediately on rising in the morning; to sleep on a mattress, and to get up immediately on waking; to take regular and vigorous exercise, short of fatigue, a good and nutritious diet without stimulants; to sponge the lower parts of the body with cold water

before retiring to bed. The medicines were, two compound rhubarb pills every other night, for three doses; to take half a drachm of the tincture of the sesquichloride of iron three times a-day in a little infusion of quassia. The medicine was taken for a fortnight, when he went to school, cured of the nightly habit, which I have heard has not since returned. He was ordered to continue the baths, &c., as a preventive.

419. I consider this state foreshadowed a weakness of the prostatic sphincter, which would, under favourable circumstances, have eventually developed itself into disease, but which, with care, could be staved off. I have had many cases of this description, particularly amongst children born in India.

420. The following may be considered to be a step further in the affection, namely, where in early youth the warning of the weakness of the prostate has been overlooked, and the irritability has been transmitted backwards to the vesiculæ seminales, which, by contraction, have responded to the slightest irritation; of course the nervous centres of the cord must be the mode of transmission of the irritation, and may be probably, in many cases, the primary cause of the affection; but in the instance under consideration the prostate and neighbouring organs were in fault.

Case.

421. A young gentleman, aged seventeen, consulted me on account of an irritability of the genital organs, connected with an hypochondriacal form of indiges-

tion. He stated that the irritation of walking, and the rubbing of the trousers against the penis, was sufficient to cause an emission—that he also had one nearly every night, and he found it weakened him very much; he dreaded to go to sleep, lest they should come on; he complained of a peculiar pain in his head, as if the top was opening and going up a considerable height, and then coming down again. He was very apprehensive about his condition, and was continually dosing himself with one thing or another.

422. His mother, upon inquiry, told me that she was very uneasy about him; that he was so altered, and so weak and exhausted after his return from college every day, that he would throw himself into a chair quite knocked up. His appetite was good. As a child, he had been accustomed to wet the bed nightly, and it could not be arrested. At one time, for a short period, he hesitated in his speech, but this did not last long. I recommended cold sponging baths night and morning; to lie on a mattress, to leave off stimulating diet, wine, and smoking; to take more exercise, and to take every night a teaspoonful of spirits of camphor, and daily a mixture of the sulphate of magnesia, the disulphate of quinine, and sulphuric acid. Under this treatment he improved for some time, but on leaving it off the nocturnal emissions again returned.

423. His father told me, that when a youth he himself had been accustomed to much the same symptoms, and that he had had a bougie passed, which very much relieved him. I thought that a

slight cauterization of the prostatic urethra would be needed. It was consequently done, and I believe with complete success, as I have heard no further complaints. This case is not at all an uncommon one. The hereditary tendency is transmitted to the son, and upon puberty and sexual excitement the already weakened prostate yields to the stimulus, and allows the secretion to be poured out at the slight irritation of the skin by the clothes, or by the over-excited imagination at night.

424. If the affection had consisted merely in an over-irritability of the nervous centres, it would have yielded to the treatment I had at first adopted; but persisting, after benefit had been derived from it, upon the cessation of the medicines, &c., together with the knowledge that the father had himself suffered in the same manner, convinced me that the fault lay in the prostate itself, and that, by cauterizing, a change would be set up in the organ, which, with judicious treatment, would prevent the further continuance and increase of the disease. The age being only seventeen, and the irritability having lasted but a short time, and being taken cognizance of almost immediately, it is reasonable to suppose that, with care, a relapse might not be expected, but if it did, that a repetition of the treatment would arrest it.

425. The third case is the one I have already mentioned at the commencement of this division, and is an exceedingly interesting one, as the contrast between his condition before and after treatment was most marked.

Beyond this age, the body, although weakened to the highest degree, does not call for our chief care; it is now the brain that suffers, and it is generally for some tendency to insanity or fatuity for which we are consulted. The following case, I trust, is uncommon:—

Case.

426. A gentleman, thirty years of age, on a visit of a few days to London, consulted me for peculiar nervous headaches, which deprived him for the time of sight and the power of speech, accompanied with a painful sensation, as if the head was much enlarged; he was completely paralysed in his lower extremities, and had been so since his youth, so that they were stunted; he rode much on horseback, and hunted, being attached to his horse by straps; he was wealthy, and of good family. The headaches did not last long, but they frightened him, and made him very nervous.

427. He told me he was an habitual masturbator; that he knew this was the cause of his troubles; but he could not, and would not leave it off, and it was no use advising him; he only wanted something to relieve his head. What could be done with a man like this? I saw him three or four times before he left London, but have not heard of him since. When this habit is carried into middle life, as in this case, it is most difficult to break, for the mind is so warped from all the finer feelings, that it is almost impossible to argue with such an individual, and the passion for the opposite sex has entirely died out: to re-awaken it

is our only chance. But it requires firmness on the part of the medical adviser, as there is a repugnance and shyness felt towards women, which the patient in vain endeavours to overcome. They have doubts of their own ability to consummate, and therefore feel great diffidence in the attempt. Judicious advice and great firmness may at length triumph.

Case.

428. A solicitor, about forty, always accustomed to a slight hesitation of speech, had lately become much worse; his friends observed great absence in his business, and communications with them; and the hesitation became so great, that he could hardly speak. One day, on going upstairs, he became giddy, and temporarily lost his sight, with extreme headache. From this he recovered, when, a short time after, he consulted me for a gleet. On examination, I found that it consisted almost entirely of mucus and epithelium, a very few spermatozoa occasionally passing; but he was in an extreme state of prostration bodily, and his mind was almost entirely gone.

429. His affairs were very involved, and he could give no clue to their re-adjustment. Upon inquiry, it was discovered that he was living with a female, and was giving himself up to excess of venery. His stamina was not sufficient to stand against so great a drain, and weakness of the urethra was the result. This soon gave way to proper treatment, but his brain was in such a state, that removal from business and town was deemed necessary to complete a cure.

430. In this case hesitation in the speech, as I have noticed in many cases, was one of the first of the nervous symptoms induced by the great drain of semen from the system.

Although not arising from disease, but from the loss of seminal fluid, the brain yields beneath the continual depressing influence of the withdrawal of so much nerve force from it, as, on account of his profession, he was obliged to employ it continually, whereas, if he had completely rested the brain, he might have been able to have borne up against the waste for a much longer time: it was the double labour which overcame him.

431. Those with an hereditary taint suffer much earlier, than those in which the affection has been induced; the weakness of the prostate, long before puberty, manifests itself in the frequent desire to pass water, the inability to retain it, and, in fact, in a peculiar diathesis both of the body and mind, which cannot be described, but can be perceived in numerous peculiarities, which strike the observer as a whole, without leaving evidence enough to particularize.

432. Although an individual may be modelled with an atonic condition of the prostate, he may be so situated by external circumstances as never to be made aware of it; so that there are exciting causes, which, by attacking the weakened part, cause it readily to yield, which upon a man without such tendency, would have no effect.

433. Some of these exciting causes are, phymosis, ascarides, fissure of the anus, hæmorrhoids, gonor-

rhœa, gleet, venereal excesses, or even ungratified excitement, abuse of alcoholic drinks, irritable affections of the skin, and sedentary employment.

434. The induced cases generally are found in middle-aged men, or those who, by extreme measures, have brought themselves into this condition by every conceivable excess; and it is the conjunction of several of the exciting causes acting upon the same centre for a considerable time which produces the disease. The influence of a hot climate upon a European constitution is one very fertile inducement of prostatic paralysis, for here many of the exciting causes are conjoined.

435. Heat, torpid liver, hæmorrhoids, luxurious living, little exercise, venereal excess, and much drink, frequently alcoholic, serve to concentrate upon the prostate various abnormal influences, which, together, produce degeneration and partial paralysis of that organ. Many an old Indian could indorse what I have said, if appealed to. The children of these men bear stamped upon their image the flaw in the die from which they are impressed.

436. Under the head of Pathology, I have shown the amount of injury which is frequently found in the part itself, and this is of a kind which no general form of treatment, however judicious it may be, will relieve. Although for a time the symptoms may be allayed, yet upon any loss of strength, or in case of over-excitement of the part, the disease will return, frequently with greater violence.

437. The local treatment is regulated by the state

of the part; where the prostate is not enlarged, and where the disease arises simply from an atonic condition of the mouths of the ejaculatory ducts, a slight cauterization, repeated once or twice, will be sufficient, together with general treatment, to afford relief. Cauterization is effected by passing an instrument, devised for the purpose, down to the parts, and there forcing out an ointment composed of nitrate of silver and lard, or chloride of zinc may be used. The choice of the caustic requires some little judgment, as the nitrate may act admirably in one case, and not be so successful in another.

438. Where the mouths of the ejaculatory ducts are so affected as to require the cautery as recommended by Lallemand, much care is necessary; and it should never be used, except the patient is under your immediate care, or can be watched afterwards by some medical man, as an irritation is set up which takes many days and careful treatment to allay; although, if watched, there is no danger, still the patient must make up his mind to rest entirely for a week, to take hot baths upon irritation arising, Dover's powder, hyoscyamus, or conium at night, and abstain from stimulating food and drinks, and drink barley-water, or some other mucilaginous fluid.

439. Where the prostate is much enlarged, our object must be, first to bring this down to its natural size, otherwise the cure will never be a permanent one. The mode of doing this is to apply an ointment to it, composed of the chloride of zinc, iodide of potassium, and lard; this should be applied three

times a-week—it gives no pain, and does not prevent the patient taking moderate exercise.

440. At the same time, I am accustomed to use the same ointment applied to the back of the prostate, through the rectum, on the alternate nights, as I find that it assists the cure very materially. I am enabled to do this with the aid of an instrument which I invented for the purpose, and which somewhat resembles a speculum slightly bent, through which is passed a curved whalebone and sponge, by which the ointment is applied. The treatment must be continued until the prostate is so much smaller as to allow the application of the nitrate of silver to the mouths of the ejaculatory ducts, as I find that the nitrate has a tonic, as well as a caustic, effect, and is better adapted to the latter operation.

441. Another local form of treatment, and of great use in allaying irritable conditions of the bladder, vesiculæ seminales, and even of the testicles, is the introduction into the rectum of ointments containing opium and the compound gall ointment; they have a very admirable effect in many cases of chronic irritation, and should not be lost sight of in the treatment of these affections. The local applications of heat and cold are of great utility, the former to allay irritation, the latter as a general tonic to the parts. I generally recommend the use of cold sponging to the testicles and groins before retiring to rest, in all cases of weakness of the parts, where there is no irritation set up by the remedies.

442. I may mention electro-magnetism as a form

of local treatment, to stimulate the functions of parts which have become torpid. I apply one of the wires, with a broad metallic termination to the lower part of the spine, and the other, sometimes to the testicles, at others to the groins; or again, by a metallic sound covered with gutta percha, all but an inch at the end, to the ejaculatory ducts, prostate, and vesiculæ seminales. I find that this has a powerful effect in awakening the exhausted powers of the generative organs. Great care must be taken in not making use of too powerful an induced current—the amount is easily regulated.

443. The general treatment of this affection may be divided into three heads;—to increase the tone of the system, to improve the quality of the urine, and to allay nervous irritability. It is true, by doing one we naturally must, to a certain degree, do the other; still I prefer dealing with each separately.

444. The finest tonic in this disease is the shower-bath; it acts—not immediately, it is true, but after some time—in the most admirable manner, improving the tone of the muscles, giving general vigour, allaying nervous irritability, arousing fresh hopes, and assisting very materially in the cure. The bath should be taken the first thing every morning, on rising from bed. Cold sponging at night may be combined with its use, and the patient should always lie upon a mattress, and sleep upon his side, so as to avoid heating the loins.

445. The next most important point is, the proper regulation of the bowels. The patient is almost in-

variably costive, and to obviate this much trouble is frequently experienced in the early treatment of a case. To suit most patients, there is nothing like the sulphate of magnesia, in regulated doses, every morning upon waking—from two drachms to an ounce and a half being sometimes required; as the patient improves, the bowels become much more manageable, especially when he is enabled to take regular exercise. Rhubarb is a safe and useful aperient. Articles of diet, such as oatmeal porridge, jams, treacle, prunes, &c., should be made use of.

446. Amongst tonic medicines, the tincture of the sesquichloride of iron takes the first place, as it has a specific effect upon the genito-urinary tract apparently, arresting secretion and increasing the tone of the parts.

Sulphuric acid has somewhat the same effect, and may be given where the iron is found not to agree. There are other tonics which may be used, but do not require mention here, as they are in no way specific.

447. The urine is generally abnormal, and should be always carefully examined, as much useful information in reference to the general treatment may be derived from its perusal. I have already mentioned the treatment for some of the affections accompanied by change in the condition of the urine, and we can be guided frequently to useful results by adapting our remedies to the indications pointed out by its appearance.

448. But besides a change in the urine, irritation of the bladder frequently accompanies disease of the

prostate. The urine is loaded with mucus, and frequent desire to pass it distresses the patient. Four or five grains of the compound ipecacuanah powder in infusion of buchu, every four or five hours, acts most admirably. Buchu is a drug which should always be associated with irritation of the genito-urinary passages; it is diuretic, diaphoretic, a stimulant and tonic combined, and should be given as the fresh infusion.

449. Nervous irritability is one of the symptoms accompanying this diathesis. For that there is a diathesis I have no doubt, and the cases which I have seen—some of which I have mentioned—will, I think, prove it. To allay this must be our endeavour. The mind is in that state ready to receive any impression—particularly any depressing influence; there is a morbid desire towards melancholy subjects in the conversation, a fear of exposure, a consciousness of inferiority, and a dread of its being known.

450. By holding out hopes of recovery, by speaking of the future, and by leading the mind from brooding on the present, a healthier tone is given to the mind, which, reacting on the body, assists the cure; at the same time, by our remedies the disease is mitigated, which reacts upon the brain, so that a universal improvement results. There are medicines which assist to calm the irritability of the nervous system, and which are sometimes called for. Valerian is one of these. There are many forms for its administration: the ammoniated tincture in the infusion is one of the best: it may be given two or three times

a-day: it acts by stimulating the cerebro-spinal system, at the same time allaying the morbid irritability.

451. Small doses of opium, or morphia, with chloric ether suspended in mucilage, calm the over-excited nervous system most effectually, and, given for some considerable time, act as a tonic. I have continued this form for three months continuously with decided benefit.

452. In all cases of depression that have lasted long, and which have been induced by causes acting slowly and by degrees, the cure is also a work of time; it is impossible by any means to effect a sudden change. If there were any drug so powerful as to impart life to the dying, and this could be given, yet the nervous system, the muscular system—in fact, every part of the body—is in so weakened a condition, that they could not reply to the stimulus; and it is only by slow progression that new vigour can be imparted to these systems, by improving their nutrition; then the stimulus will produce the desired effect.

453. I trust that I have said enough to awaken an interest in a class of cases which I fear have been tabooed both by the profession and by the public, and have been hitherto condemned to Death, to Asylums, or to Quacks.

STAMMERING.

454. Romberg, in his first volume on *Diseases of the Nervous System*, Sydenham edition, thus describes this affection:—

"In order to pronounce individual sounds or syl-

lables, it is necessary that the muscular apparatus of the larynx, and of its tubular prolongation to the buccal opening, should co-operate. In a man who had a deep wound in the neck, Bell observed, that whenever he made an attempt to speak, which he could only do in a whisper, the glottis moved harmoniously with the lips.

455. "In a patient who had lost the bones of the upper part of his face, the velum palati was exhibited in a constant state of action while he was talking; when he uttered explosive consonants it rose, and drew back forcibly when the lips separated, or the tongue was removed from the palate or the teeth.

456. "Derangements of sonorous speech arise from an abnormal motor impulse, and from disturbances of the co-ordination of the numerous nervous functions of the vagus, the hypoglossus, and facialis. An interruption of the voice in pronouncing single sounds or syllables is termed stuttering. It generally occurs when a consonant is combined with a vowel at the commencement or in the middle of a word; sometimes, when an attempt is made to pronounce a single letter, the preceding sound or syllable is repeated in explosive sounds (*b*, *d*, *g*, *k*), until the impediment has yielded. This is not done where the sound is continuous (*f*, *s*, *r*).

457. "Sometimes the column of air is violently forced through the rima glottidis without producing a sound. Other spasmodic phenomena in the range of the respiratory, irritative, and articulating movements associate themselves with temporary aphonia.

Expiration is more or less impeded, the inspiratory muscles of the neck and thorax are much agitated, the facial muscles are distorted, the eyelids open and close forcibly, the alæ nasi play, the lips jerk up and down, and the tongue is forced in spasmodic snatches against the upper or lower row of teeth.

458. " The clonic spasm sometimes passes into one of a tonic character; the voice is silenced, the mouth closes firmly, the tongue softens, the face becomes crimson, and the veins are swollen; the patient is in a state approaching to suffocation until the spasm is relaxed and the sounds are again given forth. The convulsive obstacle only occurs in sonorous speech; there is no difficulty in articulating if the individual confines himself to a whisper.

459. " The male sex has by far the greater predisposition to stuttering. Colombat asserts that one person in 2500 stutters, but only one woman in 20,000 is affected. Childhood and youth peculiarly predispose to it. It is rare before the fourth year; it increases from the seventh to the fifteenth; so that one-seventh of the whole number belongs to this period of life. Old age carries with it a spontaneous cure of stuttering. It is frequent to meet with hereditary disposition: two-fifths of the cases mentioned by Colombat asserted that it was a family failing.

460. " Intestinal irritation, the development of puberty, exhausting—especially spermatic—discharges, mental emotions and irritation, have been observed to cause the complaint. The atmosphere exerts an occasional influence on stutterers. Many persons have

a presentiment of atmospheric changes in the greater difficulty of articulating; dryness of the air favours its occurrence. Nothing is more apt to increase it than embarrassment, timidity, expectation; while it is diminished, or ceases, as soon as the individual affected is left alone, or in the dark, or puts on a mask. There is an undeniable reflex action upon the mind, for stutterers are irritable and shy."

461. Volkmann has proved that when the vagus has been separated on both sides of the neck, the chordæ vocales instantly closed; but it is not alone upon the vagus, or any one nerve, that stammering depends, although one nerve may be affected more than another, but usually the whole respiratory system of nerves are more or less in fault.

462. I consider stammering to depend upon a want of combination in the action of the nerves supplying muscles of respiration, those influencing the vocal cords, and the nerves supplying the pharynx, tongue, and the various muscles called into play in forming the syllables in the cheeks and lips. If different stammerers be watched, each will be observed to have his own peculiar difficulty. Some cannot pronounce certain letters without an immense effort; they can see such a letter in a sentence which they are speaking before coming to it, and the knowledge of the difficulty will throw them out; and in seeking for some other word to replace the one found difficult to pronounce, they become so discomposed and nervous that control over the voice is completely lost; a

spasm is the result, and the patient is not relieved until fresh inspiration is made.

463. I have seen a stammerer with his lips pushed out ready to pronounce the letter B, get nearly black in the face in a vain endeavour to unclose the lips; and until the idea is given up altogether, and a fresh inspiration taken, no sound is emitted. He stated to me that his tongue clave to the roof of his mouth, and his lips clung together, without any possibility of unclosing them, until the effort was relinquished.

464. The continued desire merely keeps up the state of spasm. It is very difficult to discover which of the muscles, and nerves supplying them, are principally affected; and it is useful to do so, on account of the exercises to be given in producing a cure.

Stammering may be produced excentrically by some irritation affecting the peripheral system of nerves, reflected from the centres, improperly combined to produce the desired effects.

465. Most stammerers read much better than they can speak. The reason of this is, that the powers of the mind are not called upon to make a choice of words; there is a perfect flow of words; so that the attention is not called off from the proper combination of inspiration with vocalization, which is the great difficulty to be surmounted, and the chief cause of nervousness. The finding appropriate expressions and words to make use of is removed. In public speaking, there is always more or less hesitation, and from this cause; much more, then, does this affect

the stammerer, who is of a nervous and shy disposition generally.

466. From my observation of stammerers, nervousness calls forth the impediment more than any other cause. A gentleman, who, in a room by himself, has been reading pages, without once hesitating, or feeling any inability to continue for an unlimited time, on the entrance of a stranger will stammer immediately. This is caused by the imagination, by a train of ideas, by a want of confidence, which brings back to the mind the knowledge of the impediment; and being conscious of the inability occasionally to articulate, that state of mind is induced; and a nervous trembling seizes upon the frame, short inspirations are taken, and articulation is arrested.

467. If the mind is calmed, and the person addressed so as to remove his attention from his impediment, and without excitement allowed gradually to enter into conversation, as he becomes used to you, and the strangeness wears off, and if the confidence of the patient be obtained, he will gradually be able to speak more easily to you than to another person.

468. I shall not enter into the method of treatment by conversational and reading exercises, as they are tolerably well understood by the profession; the regular filling the lungs with air before the commencement of a sentence; the choice of words, avoiding those containing the letters in which the impediment consists; never speaking in a hurry, but taking *due* time, so as to calm the mind and give

confidence; never to *burst* at a sentence, so as to carry it through, as it were, with one effort, which effort requires so much consumption of nervous energy as to remove the possibility of making many such without being followed by extreme prostration.

469. I have known a stammerer, after having made extraordinary efforts to carry on a conversation with a stranger without being discovered, become perfectly exhausted. It is this waste of nervous energy required to hold a conversation, which, re-acting detrimentally upon every other portion of the nervous system, generally undermines the constitution, giving rise to disease; or, more commonly, adds fuel to the fire already burning up the life of the stammerer.

470. A man who is unable to speak without an effort, or without calling up a sneer or a laugh in the person he addresses, is loth to place himself in such a situation: he therefore shuns society; he is lonely, and a misanthrope; morbid ideas arise in his brain, and melancholy saps the springs of life. He seeks no partner in life, for fear (a mistaken one) of exciting ridicule; and thus, deprived of the purer joys, he, as it were, shuts himself out from his own class, and seeks companionship in a lower and inferior grade.

471. This fear is too often the case in many a one who considers himself, from one cause or another, unworthy to associate with his equals of the opposite sex. This consciousness of inferiority or unworthiness, expressed towards those of his own class, amongst whom he would be entitled to seek for a

wife, is, I know, one of the most constant accompaniments of the affection; and, until some amelioration takes place, no arguments are of any avail. At the same time, it is remarkable with what elasticity the spirits, which had been formerly bound down by the leaden weight of the disease, spring up when benefit arises from treatment, and hopes are given of an ultimate cure.

472. Careless, with no desire of advancement, with no aspirations, desirous only to pass through life with the least possible amount of annoyance on account of his defect, and without a hope for the future, is the state of the young man afflicted with this painful disorder; for not only does the body suffer, but—what is far more important—the mind is secondarily affected, and eventually gets into that morbid irritable state, as almost to amount to insanity.

473. I have heard it stated that stammerers never attain old age. This is not exactly correct. It is true, very few middle-aged men stammer; the reason for which is, that a man is either cured or dies before arriving at middle age.

474. Stammering is generally found in children, and, in the majority of cases, is accompanied by incontinence of urine. It is, in nine cases out of ten, an hereditary failing. This is difficult to ascertain, I grant, but it will be found correct. In the youth, stammering is, in most cases, found to accompany voluntary or involuntary seminal emissions; and the same in young men. I do not think this is generally known; but, having had several cases of stammering

under my immediate charge, in which I had discovered the cause of the affection—consequently its cure—I have been enabled to institute inquiries amongst a large number of youths and young men thus affected, and I find that my assertion is borne out by facts.

475. In the child, the neck of the bladder is in an irritable condition; there is a want of tonicity about the sphincter vesicæ and prostate; and this is not to be referred entirely to the nerves supplying the part and the spinal centres, but to the muscles and mucous membrane themselves, and arises from an error in the formative power conferred upon the embryo at impregnation by the parent. This either grows with the growth, dependent upon circumstances, upon the diet, upon the clothing, upon sleeping, upon luxuries, upon hardships, upon education, upon reading, upon tendencies, upon ideas created in the brain from external objects, upon ideas occurring in the brain induced by the condition of the parts, upon the spinal cord,—or upon a thousand occurrences and accidents which it is impossible to mention, or even to know.

476. It may, on the other hand, be eradicated through the opposite causes taking place. Many believe (and the evidence is satisfactory) that the cerebellum exerts a powerful influence upon the sexual desires, and that it is the principal great nerve centre called into action during coition. That it is the seat of the combination of the immense number of nerves governing the muscular contractions required to consummate the act, there is now little doubt; but, further than this, it is believed it exerts some specific

influence upon the sexual sense. This may not be the case; yet, on account of the cerebellum being always called upon so powerfully to aid the act, it may have an inherent or induced sense in connexion with it. The lower part of the spinal cord is the first centre referred to by the organs of generation; the cerebellum is the second, and the cerebrum the third.

477. I have endeavoured to show that stammering depends upon a want of combination of the muscles called into play to produce vocalization and articulation, and that this error of combination depends upon some inherent defect in the cerebellum.

478. That it must depend upon an inherent vital error, is proved by the affection showing itself before any secretion of semen has appeared—consequently cannot arise from any drain upon the system, except so far as the continued exhaustion of the nervous fluid by the frequent calls upon the centres, induced by masturbation. It is probable, however, that this habit would not give rise to stammering, except from there being already a predisposition to the affection. There is not, however, the slightest doubt that it excites it; and as long as the habit is carried on to excess, there is but little chance of effecting a cure.

479. The first thing to be done in treating stammering is, to discover if this habit is habitual, and if so, to stop it immediately, either by advice, which is generally sufficient (it being practised entirely through ignorance of its being detrimental to health, and acquired at school, or induced by the irresistible desires of nature), or by blistering the penis, or rubbing in

tartar emetic ointment, or any other means which will put a stop to it.

480. Secondly. By increasing the stamina of the patient by a judicious diet, good and regular exercise, mental labour, such as mathematics, natural philosophy, chemistry, &c.—some study that will lead the mind from man to matter. The cold bath night and morning, a hard bed, a sufficient quantity of sleep, but rising early, and immediately on waking.

481. The medicines must be such as are suited to each particular case; purgatives, when required; tonics; the tincture of the sesquichloride of iron and sulphuric acid are, I believe, to a certain extent, specifics: quinine: strychnia is occasionally, where the spinal centres appear to require stimulating, of the greatest value, and may be given with confidence, and continued for some time; the dose should be small, frequently repeated.

482. Zinc I have found of great utility, and it may be combined with iron advantageously. Arsenic, where there is much irritability of the muscular system, from irregular action and want of tonicity in the cord, may be relied upon, and will frequently effect a cure where all else has failed. In chorea, and the like affections, arsenic is, in general, the very best mineral tonic that can be used. Combinations of these should be made.

483. Where there is actual disease of the parts about the prostate, the treatment should be such as is laid down in a former chapter.

Thirdly. The mode of educating the muscles made

use of in vocalization and articulation, so that they shall combine to produce normal speech.

It is singular how rapidly the patient will find his difficulties fall away before the general tonic treatment, and the arrest of masturbation, if practised.

484. But, to increase the rapidity of cure, a few rules to facilitate articulation may be given.

1st. Always speak slowly, and be prepared with the ideas which you are about to put into words before commencing.

2nd. Endeavour as much as possible to avoid words containing the letters or syllables in which the impediment consists.

3rd. Always fill the lungs with air before commencing the sentence; and when the use of a word containing the letter or syllable is found unavoidable, again fill the lungs with air.

4th. Never attempt to articulate the letter or syllable when the lungs are nearly empty. Take a fresh inspiration.

485. Practise the above four rules by reading aloud in a room alone, until no difficulty is found. Also, learn by heart a speech from some poet or orator, and practise the delivery of it, with the aid of the rules. After reading alone, read aloud before one or more persons, so as to overcome timidity. When tolerably perfect in these exercises, commence conversation with relations and friends—never (if possible) with a stranger—always practising the rules; and never, when once having commenced their use, speak in the old way.

486. If the rules are found irksome or difficult to use, rather be silent, as the return to the impediment voluntarily, and without an effort to counteract it, acts not only detrimentally upon the process of cure, but reacts upon the mind, removing confidence, and tending to hopelessness. Never join in a desultory conversation where several persons are speaking, as the ideas are liable to become confused, and the speech generally sympathizes.

487. Follow out one train of ideas; and when commencing a fresh subject, collect the ideas, and concentrate them upon it. Endeavour as much as possible in conversation to avoid thinking of anything else; and also keep the senses from rambling. The concentration of the faculties to one point, will of itself give confidence, by removing the ever-present consciousness of the impediment. It is the latent idea of the possibility, if not the probability, of a break down, which in so many cases leads to the catastrophe.

488. When master of the rules, converse with strangers. A chat with a person, without betraying the impediment, will be of the greatest possible advantage, and raise the spirits and hopes of the patient in a remarkable degree. When the cure is advancing favourably, the patient will notice that some days he can speak better than others; and even on rising in the morning he will be aware of this before even speaking a word: this is dependent upon the state of the health, and may be obviated by correct hygienic and medicinal treatment.

489. It is impossible to give the particular rules required for each separate form of impediment, as they are as numerous as the letters of the alphabet and their combinations; but the four general rules are applicable to all, and may with practice be used in every case; and it will be surprising to the patient, with how much greater ease he can speak, and how rapidly he improves, when he has once mastered them. It is, with the young, necessary to be continually impressing the value of, as well as even the rules themselves and their application, upon them. As a little trouble and attention is required in carrying them out, they are too often looked upon as a task to be avoided when possible.

490. In conclusion, I may say that, if the hereditary tendency be clearly made out, and the exciting cause of the irritation be correctly diagnosed, there is no case of stammering, however painful, which may not be cured. The instance I have mentioned in a former chapter was one of the most distressing I ever saw, and, after having resisted many attempts, yielded rapidly to treatment, the exciting cause having been discovered.

491. There is one method of treatment which I have used with success in two cases; namely, electro-magnetism. A young man who had been unsuccessfully treated by a surgeon who professes to cure stammering, came to reside in my house for a short time, to endeavour, if possible, to speak well enough to pass an examination for a public appointment. As there was not sufficient time to devote to the regular

method of cure, I applied electro-magnetism to the spine and muscles about the tongue, throat, and thorax.

492. His impediment consisted in an inability to open the lips, and remove the tongue from the roof of the mouth, where it became fixed for a time. He stated that, after the application of the electricity, his tongue and lips appeared loosened, and he was enabled to speak with perfect fluency for a time, varying from one to two hours, when the old stiffness gradually returned. This gentleman is now in India, having been present at the attack on Bushire.

493. If command can be obtained over any one muscle, or set of muscles, it is a great help towards the cure: thus, for instance, it is very common with stammerers for the tongue to rise to the roof of the mouth, and there remain fixed. If the patient is able, voluntarily, to overcome this by repeating all he has to say with the tongue fixed against the lower teeth, one great step in advance is obtained; and although it is not a very elegant mode of speaking, it is still a very effectual one, and in some of the slighter cases is alone sufficient to obviate the impediment.

494. No stammerer need despair. If not a cure, such an alleviation may be produced by correct treatment as to afford him every opportunity of passing through life with comfort and satisfaction to himself. It is true, that a relapse may now and then take place, through carelessness or want of tone, either of body or mind; but they always yield to treatment, and each time generally with greater rapidity than the

former one, especially when full confidence is established between the patient and his adviser.

495. HYSTERIA

Is essentially an affection of the nervous system, and pre-eminently of the sympathetic. It is the mimic of disease, and, if understood, the prognosis is always favourable. It is generally an affection of debility, requiring stimulating or tonic treatment. It is more common in women than in men, and in the latter is generally termed hypochondriasis; it is, however, the same affection, modified by the difference of conformation of the sexes.

496. Hysteria is frequently the result of excitement of the generative organs, and in many cases is caused by the desires of nature remaining ungratified; this, perhaps, is one reason why it is more common among women than men. It is not my province, in the plan I have laid down for myself, to enter upon the common hysterical fit, or the usual and well-understood symptoms of hysteria, so admirably and graphically described in Dr. Watson's *Principles and Practice of Physic*, but upon the more obscure forms, which simulate, and occasionally degenerate into, organic disease.

497. The hysterical may be primarily divided into two great classes—the languid and the excitable.

The languid class is generally found amongst young girls about twelve or fourteen years of age, who are weighed down with an oppressive feeling

which they cannot control; they dislike arising in the morning, preferring dozing in bed; they are a long time dressing; they dawdle over this and over that; they have no desire for breakfast—are dainty. If called upon to exert themselves, either mentally or bodily, it gives them a headache—an oppression at the top of the head; they cannot eat meat, but prefer puddings and bread-and-butter, sweets, and other indigestibles.

498. They complain of pain in the hypochondria, sometimes one side, sometimes the other; suffer from wind. They have a languid appearance, but are stout and flabby; complexion ever varying in its tints, sometimes pale, at others yellow, or green, or dark under the eyes; the conjunctivæ are bloodless and yellow; the tongue, when protruded, is large, flabby, pale, and indented by the teeth, frequently with a whitish fur at the back, especially in the morning; rest does not seem to benefit them, rather the reverse; the pulse is languid and irregular.

499. They have many complaints, Protean in their shape, taking many forms, and if listened to will increase in quantity and extent; they like being condoled with, and feel grateful for sympathy, which, however, is misapplied, and invariably increases the disorder. It would be an endless task to describe the various troubles, pains and aches, of which they will complain; sufficient to say, that there is not an organ, a bone, a joint, a tissue, or a nerve, that may not be complained of as painful or diseased; and the symptoms described so accurately, and the by-play

so well done, as to deceive the most wary at times. In these cases there is always a tendency to the paralysis of parts; a joint is so painful that it cannot be moved, necessitating rest; there is an inability to move a limb, the patient cannot walk, one arm is paralysed, &c.

500. Upon inquiry, the bowels will be found sluggish; there is a frequent desire to pass water, which is pale and copious, soon becoming ammoniacal, and frequently even passed neutral or alkaline. Any bad news, or trouble, or sudden fright, will send these patients off into a series of true hysterical fits,—laughing, crying, sobbing, yawning, hiccoughing,—with the globus hystericus, and complaints of choking; but never loss of consciousness, or actual convulsions. After the more active form of fit, they may lie for hours in a semi-syncope, breathing slowly, heart faintly acting, probably experiencing a delicious reverie, from which they are loth to be disturbed.

501. Early rising, the cold bath, regular exercise, walking, riding on horseback, and calisthenics, a judiciously-chosen meat diet, with proper clothing, are hygienic methods of treatment which should never be forgotten. A happy home, or a good school, with the faculties of the mind turned to useful and amusing instruction, never overburdening them, are found to have more effect upon this form of hysteria than almost anything.

502. The mind should always be amused and instructed, never allowed to feed upon itself, for in that case it will always foster those ideas which are

generated by the ailing organs of the body, and, by action and reaction, increase the original disease to its highest pitch. The ailing organ may now be soothed or stimulated, according to the manner of its affection; the accompanying symptoms—the indigestion, the chlorosis, the torpor of viscera, the headache, the cough, or the flatulence—may be attended to; never, however, losing sight of the *fons et origo mali.*

503. The medicines most useful are,—aloes and nux vomica, for costiveness; iron, as a stimulant to the formation of blood-cells; cod-liver oil, as a dietetic; brandy occasionally, in cold weather, as a vital stimulant; valerian and ammonia, as a nervine tonic; and certain stimulants to the uterus, as the oleum pulegii, ergot in small doses, &c.

504. The excitable class are morbidly so, fidgety, cannot sit quietly for a minute, always desirous of some change; a touch upon the skin excites them to scream, the sight of anything glittering annoys them; a spider, a mouse, or a black-beetle gives rise to a feeling of repugnance and horror, which, although they allow to be foolish, they state they cannot control. They are quick-tempered, affectionate, easily quarrel, and easily make friends again; they are generally of a spare habit, quick in their movements, talk quickly, running rapidly from one subject to another, liable to diarrhœa, hæmorrhage from the nose, colds, coughs, &c. On arriving at twelve or fourteen, if the menstrual flow does not supervene, all the previous peculiarities are exaggerated; and

we may have chlorosis, chorea, or even epilepsy. The tongue in these patients is generally red and pointed, and the pulse quick and irritable.

505. In this form of hysteria, there are local hyperæsthesiæ, sometimes of one of the great centres, sometimes of a smaller one, excited by slight causes, and the centre exalted determined, by some trivial external irritation, such as a touch upon the skin, exciting a paroxysm. The reflex function is in a highly excited and exalted condition, owing to the great centre of control, the brain, being in a *meionæsthetic* state; the uterus and appendages do not properly perform their function, and the nervous energy which should be concentrated upon those organs, removing certain obnoxious ingredients from the blood, is flying about the nervous system, exciting first one centre and then another to increased and irregular action.

506. Without mentioning all, we see the respiratory centre affected in the spasms of the glottis, the pharynx, and even the bronchi themselves, producing dyspnœa; and when those muscles are affected, which, by combining their action, give rise to a cough, the peculiar hysterical bark is the result. Then, again, the cardiac centres may be the seat of the disorder; and palpitation, pain in the arm, and a sense of anxiety, and fear of death, may ensue. If the hypogastric centres; pain in the loins, hips, and thighs, and difficulty in passing water with frequent desire, ensue. The affection may go on to epileptiform attacks.

507. The centres of sensation are also occasionally affected in the same transient manner, local neuralgia, in any portion of the body, shifting about, or sometimes obstinately stationary, resisting the usual forms of treatment for neuralgia, and yet easily yielding to the anti-hysterical drugs. The sympathetic system is always affected, as is proved by the liberation of gas in certain portions of the intestinal canal, the secretion of watery urine, the flow of tears, and leucorrhœal discharges.

508. A very general symptom complained of by most hysterical patients is a sense of sinking, referred to the pit of the stomach, as if of emptiness; a burning pain in the same situation frequently follows this. Pain in the right or left hypochondria is nearly always present during the attacks; and the stomach is sometimes enormously distended with gas; less frequently, the bowels are very much inflated, being quite tympanitic. I believe also I have detected distension of the spleen during a fit of hysteria.

509. Salivation is an uncommon symptom in hysteria, but I have seen it more than once: it appears to be coexistent with gastric catarrh, and is sympathetic with it. Arrest or increase of secretion always accompanies hysteria. Arrest of one, increase of another, apparently without any connexion, should not surprise us. The discontinuance of the menstrual flux is so general a symptom, that by many physicians the uterus, or the reproductive organs as a whole, are looked upon as the very origin of the evil,— the organ, the arrest of whose function upsets the

rest of the system by sympathy. I consider, however, that it is merely a symptom or effect of the hysterical diathesis; certainly only one of the causes.

510. Hysteria frequently simulates epilepsy.

Case.

A young lady, aged twelve, born in India, of a delicate and highly nervous organization, during the cold weather of the late winter complained of cold and shivering, and was well wrapped up and placed near the fire. After a short time she suddenly fell, and when I saw her was in as perfect an epileptic fit as ever I witnessed. Pale, haggard, foaming at the mouth, throwing the head back, and from side to side, convulsive motions of the arms, followed after the fit by severe headache, and pain in the muscles convulsed; she was completely unconscious.

511. I placed a large black silk handkerchief over her face, as is my custom, and she soon became quiet, and fell into a heavy sleep. Knowing her constitution, I looked upon this as a sign of the advent of menstruation, and I considered it merely as the result of a strong shock to the great centres, propagated from the nerves of the uterus, which was incapacitated, probably by the cold, from exercising its function. I placed her upon brandy and ammonia, and the next day gave her some purgative medicine.

512. I noted the day in my pocket-book, and told her friends to give her two purgative pills and a warm hip-bath that day four weeks; in the meantime, to sus-

tain her powers by nourishment and stimulants. This plan was carried out, and on the thirtieth day I was sent for. She had had a very slight attack, which only lasted a few minutes, the black silk handkerchief having been used immediately: the same treatment was resorted to as on the last occasion. On seeing her the following day, she complained of nausea, bringing up everything that was given her; also diarrhœa, with pain: there was pain in the neighbourhood of the left ovary upon pressure.

513. I ordered her brandy and ice by the mouth, and an enema of starch, with half a drachm of laudanum. The next day she was better, had no sickness or diarrhœa, and free from pain, or even tenderness upon pressure; complained of weakness. Good diet, with wine. She had the pills and warm bath twenty-eight days after this attack, and has had no bad symptoms since; has not, however, menstruated at present—May.

514. This case, which was the result of some powerful impression, propagated probably from the left ovary to the spinal cord and brain, resulting in a perfect epileptic fit, may be quite correctly placed under the category of hysteria; as with care the menstrual function will be eventually set up, and probably she will never have a similar attack.

There are many points in the case which are singular, and worth study, especially the simplicity of the treatment.

Case.

515. I was sent for suddenly one evening to see a woman in a very severe fit. I found her lying on the ground, struggling violently, in an epileptic fit; she had been in it for about half an hour, and she continued for an hour more. I placed her on a mattress, protected her head and arms with pillows, sprinkled water on the face, undid her clothes, &c. This was an undoubted epileptic fit, as described—perfect loss of consciousness, frothy saliva from the mouth, convulsions—first more marked on one side, then on the other—with violent expiratory efforts; the face livid, the eye fixed, teeth grinding; in fact, every symptom of a true epileptic fit.

516. She was a servant, and her mistress wished her to be removed into a hospital. I ascertained that she had never had a fit before, and that the menstrual functions were irregular. I had her removed to St. Mary's; and upon explaining the case, an emetic was administered, followed by an active purge. She was better the following day, merely suffering from the effects of the convulsions, soreness and stiffness of the limbs; a little alterative medicine, with tonics, eventually induced the menstrual flow, and she got quite well, and has never had a fit since, now nearly three years.

This case is very similar to the last, only in the former it was a young girl; in the latter a middle-aged woman, probably near the change of life.

517. These were both actual epileptic fits; but the affection was not epilepsy, but hysteria. Both these patients evidently were of the irritable type; their motor system of nerves were easily excited. It is difficult, perhaps, to account for the total loss of consciousness, not common in hysteria. The mind, or rather the will, in hysteria, appears to be in a lethargic state, but not so far suppressed as not, in case of sufficient mental stimulus, to be capable of answering to it; but in these cases the mind was entirely suppressed; apparently the whole nervous energies were concentrated upon the motor centres, and these without the supervision of the brain—probably not even of the cerebellum.

518. The principles of treatment were in the first case, during the attack, to sooth the irritability of the nervous system by the application of the large black silk handkerchief over the face. How this acts I cannot pretend to say, but that it has an effect in the milder forms of epilepsy I have good reason to know. After the fit the viscera were cleared, the secretions stimulated, and a liberal diet, with stimulants, allowed, supporting the vital powers.

519. In the second case, during the fit, a very severe and prolonged one,—protection from injury, and by dashing cold water over the face and neck, endeavouring to stimulate the respiratory centres to normal action; this, I think, failed, the fit wearing itself out. The after-treatment was to relieve the viscera, stimulate the secretions, and, by alteratives and tonics, set up the menstrual flow. Both these

cases did remarkably well. The conclusion is, that the treatment was judicious.

520. In my attendance upon young ladies, I frequently see cases of lameness—young girls, instead of walking elegantly, stumping along on their heels, or walking sideways, dragging one leg after them; or apparently a kind of paralysis in the loins, so that when once sitting down, they have a great difficulty in rising, which they manage in a most awkward manner, by throwing their head forward, so as to tilt themselves off the chair. Contraction of a limb is not uncommon: and the heel may be drawn towards the buttock.

521. I have seen many instances of all these, some lasting a considerable time; they never, however, give me the least uneasiness when occurring in young girls. It is difficult always to make parents chime with your views if they do not put sufficient confidence in you. A physician may also take a different view of the case too, if you call one in. My method of treatment in these cases is to regulate the bowels, usually costive, with Dr. Marshall Hall's pil. aloes, dilute—an admirable medicine in all these forms of disease—to support the patient with good diet, regular exercise; to stimulate the part in winter with electro-magnetism, in summer with the cold douche; to give tonics when required,—iron, arsenic, or zinc.

522. All these cases do well. I remember, however, one somewhat of this description, which I was not perfectly certain about. A young girl, aged fourteen, of delicate health and rather weak intellect,

suffered from tonic spasms of the extensors of both hands and arms; there was tenderness on pressure of the lower cervical and first dorsal vertebræ, and many symptoms indicating disease of the vertebræ; but, looking upon the age of the patient, and that she had not menstruated, I considered that it was a case of hysteria, and I placed her upon my usual treatment. She did well, but I did not see the termination of this case, as she was removed from school, where she was staying whilst I attended her, to her home in Yorkshire, her parents becoming anxious and the mistress not desiring to continue the responsibility, and I had not sufficient influence with this lady to prevent her doing so.

523. There are instances of this doubtful nature which are occasionally met with, in which it is almost impossible to say whether there is actual disease, or whether it is merely hysteria, the clever mimic. I think it is always advisable to treat the case as one of hysteria. Disease will soon make itself unmistakeably evident if it is present; whereas, if the case be in the first place treated for local disease instead of hysteria, slowly and by degrees the vital principle is sapped, and the young patient is consigned either to an early grave, or becomes a cripple for life.

524. In those forms of hysteria where disease is simulated so exactly, that after many examinations and mature deliberation a decided opinion cannot be given, the administration of chloroform may in a moment unveil what had hitherto been obscure: thus the fixed and paralysed limb will relax, the abdominal

tumor will disperse in flatus, the hitherto acutely tender parts may be handled; or, on the other hand, disease may be diagnosed with certainty. These doubtful cases are not uncommon, and chloroform will then be found invaluable.

525. The hysterical never bear any artificial drain upon the fluids. Bleeding is never beneficial, although apparently it may afford temporary relief; counter-irritation, where any discharge is induced, fails to give relief. Purgatives producing liquid evacuations are not to be recommended, although purgatives are frequently, I may say generally, required; a prescription containing a small quantity of aloes and extract of nux vomica, with myrrh, galbanum, assafœtida, or iron, according to the case, is the best form, as it acts as a tonic, at the same time relieving the bowels, usually sluggish: it may be used for some time with excellent effect, and may even induce the natural flow of the menses.

526. Vomiting, a common symptom in some forms of hysteria, is generally amenable to treatment. Keeping the stomach empty, and giving nothing but small lumps of ice, with a little brandy, is the best method of arresting it.

Hysteria is occasionally the result of actual disease of the uterus. In these cases, and these alone, it is necessary to use the speculum; and this should be the last resource, after injections, &c., have failed. For an affection like hysteria, where the mind is already in a morbid condition, ready to seize upon any excuse to be considered an invalid, and throw off the

responsibility of the exertion of the will and of the mind, such a proceeding as the use of the speculum will give rise to morbid ideas, which the patient will indulge in to the exclusion of all others.

527. And yet the speculum in many cases will show us the cause of the disease, will enable us to apply our remedies, and a cure may be rapidly and happily effected. However, again I say, be cautious in the use of the speculum; when you think it is actually necessary be sure that the diagnosis is correct; for be it remembered that, according to the accounts published by some medical men, there is no opposition to be expected on the part of the patient. I trust that if this is true, hysteria is to blame, and not the mothers and daughters of England, who have ever been celebrated for their purity.

528. What, then, is hysteria? I believe it to be a partial paralysis of the nervous system generally with a want of balance amongst their centres; thus, instead of the nerve force being duly and normally distributed amongst them, some get a much larger supply, and others are paralysed; and this condition is induced by various causes, such as an hereditary disposition, a luxurious mode of life with little exercise, the force of example upon a predisposed system; any depressing influence, mental or bodily; as trouble, domestic affliction, disappointed affection, lowering discharges, the sequelæ of fevers, a too powerful purge, &c.

529. The periods at which hysteria is most liable to appear, are, during any of the great changes of life—

puberty, after conception, after child-birth, at the arrest of the menstrual flow: then, again, with young women whose passions are intense, but remain ungratified. The causes are infinite; the symptoms are innumerable; the treatment is simple, and generally effectual.

530. In hysteria, the result of lowering influences, our treatment must be directed to improving the tone of the system. As the secretions are vitiated, they must be set right; and as it is not at all unlikely that there may be a large accumulation of fæces in the bowels, it must be at once removed by appropriate purgatives, not drastic, but stimulant, as nux vomica, rhubarb and aloes, followed by castor-oil; or blue-pill and colocynth, followed by decoction of aloes, ether and ammonia. Repeated gentle purgatives should be continued for some little time after, as the paralysis of the peristaltic action of the bowels is frequently very obstinate, and must be obviated.

531. At the same time the nervous system should be supported, stimulated, and the balance of nerve force re-established; the treatment therefore must differ slightly in each case, according to the organ to be fortified; the general treatment being the same in all. Now the most valuable remedy for hysteria is galvanism; by its aid we are enabled to stimulate the general nervous system, or any particular track of nerves, or even most of the organs, certainly the uterus. Tone is restored, an increased supply of nerve force is drawn to any organ, or removed from any other, as desired; in fact, galvanism, or electro-

magnetism, is the remedy of all others. The method of administration, and some other observations upon its use, will be found under another heading.

532. At the same time exercise, walking or riding upon horseback, discreetly managed, will greatly aid the cure. The cold shower-bath, cold sponging, the douche, or sea bathing, may be recommended after a little reaction is set up; not until then, as otherwise it might be found too depressing. I have certainly seen as much harm as good done by the indiscriminate use of cold bathing; the patient should be consulted upon the sensations experienced after the bath. If a genial glow and warmth pervades the surface, and if the spirits are invigorated, then benefit will result; if however headache, cold, shivering, and depression is the consequence, then the bath will not only do no good, but positive harm, and its use should be deferred for a time, until there is more tone lent to the jaded nerves by the galvanism and medicines.

533. The more potent tonics, as quinine, iron, and their preparations, are seldom beneficial at the outset of hysterical complaints; at least, I have not found them so. I prefer the fœtid gums—the artemisia vulgaris, the mentha pulegium, artemisia absinthium, valerian; and these should be used as the fresh infusion; the oils, or the bitter principles alone, when extracted, are not so beneficial.

534. Although pharmaceutical chemists have done much for medicine, I think that many valuable remedies have fallen into undeserved oblivion, es-

pecially the simple English herbs which may be gathered in our own fields. Nature has generally planted the bane and its antidote side by side; and there are many of our English affections that can be cured by our English herbs, Hysteria being amongst them.

535. Thus I usually commence with the infusions of artemisia and valerian, eight or ten ounces to be taken warm in bed at night; at the same time two pills, composed as follows, a quarter of an hour before each meal:—

℞ Pulv. rhei. turc. opt., ʒss.
Assafœtidæ, gr. xlviij.
Ext. nucis vomicæ, gr. vj.
Ft. pil. xxiv.

Whilst taking the infusion, the patient should be kept warm, and perspiration encouraged; and friction to any part where there may be spasm should be practised. An ointment, to be used as an embrocation, is useful; the following may be applied:—

℞ Pulv. opii, gr. x.
Sp. camphoræ, ℥j.
Quinæ disulph., ʒj.
Hog's lard, lb. j.

Melt in a pipkin over a water bath for an hour, and, after cooling, rub down into an ointment; this eases pain and spasm, is strengthening and stimulating at the same time.

536. As the symptoms of hysteria are infinite, so are the remedies for them; but what I have mentioned is the basis on which to found our plan of treatment. Other drugs may be used, according to the different

forms the affection may take, and the various organs attacked. As the patient revives, and the nervous system seems strengthened, iron may be given, and very useful it is if the blood is pale or chlorotic; the soluble salts of iron are the best, the ammonio-citrate, the potassio-tartrate, &c. These are invaluable tonics, but do not appear to me to be beneficial until the excited nervous system is calmed down, and the centres are enabled to attend to the proper constituents of the blood; then iron is valuable, and quinine greatly assists to strengthen the regained equilibrium of the nervous centres.

537. In extreme cases of excitement, opium is to be relied upon to calm the nervous system; it should be given frequently, and until it has produced its characteristic effect. Whilst giving opium, the patient should be kept as quiet as possible; no opening medicine, clysters, &c., should be resorted to, or in fact any form of treatment likely to awaken the narcotized nerves. Opium is more useful in cases of long-standing hysteria, as it is in almost all chronic diseases when given in small doses, regularly, for a long period. It appears to arrest the waste of the tissues, is a gentle stimulant to the acid-secreting membranes and glands, and allays the irritability of the nervous system. There is no single drug in the *Pharmacopœia* as useful as opium.

538. Hysteria, although frequently a troublesome disorder to treat, is very seldom a fatal one, and in the great majority of cases will yield to proper remedies, steadily carried out. It is most obstinate

in those instances where there is some mental affliction of such a character that the medical attendant, or even the friends, are unable to offer a fitting consolation; and the corroding care, preying upon the great nerve-centre, the brain, saps the vital spirits from the ganglionic system, leaving assimilation neglected, and the blood imperfectly vitalized.

539. Highly nervous, or sensitive individuals, as they are called, where there is a morbid acuteness of the nervous system in recognising the irritation of external impressions, must not be treated as healthy people; they must be *judiciously* humoured; corrected, but not harshly; for, although the mind doubtless has the ability to control this excitability, there is a disinclination to wield this power; they give way to the influence, and will make no effort. It appears to me that the nervous influence is monopolized by some centres to the detriment of others,—there is a want of normal equilibrium, the reflecting centres of the excito-motory system of the cord and brain are in a high state of tension; whereas the cerebrum, or centre of will, is, on the other hand, torpid; therefore the cord has to be soothed, the brain excited. Much of this can be done, extra-medically, by judicious management on the part of friends, amusing and instructing the brain, giving proper motives for action, by bodily exercise, using the centres under the control of the will; not walking, because that soon becomes merely a reflex act, and quite mechanical; but something that requires the constant attention of the will—*as*, gymnastics.

540. CHOREA

Is a disease of youth, generally appearing about the period of puberty. It is intimately allied to hysteria, and occurs in the same description of patients. It is a disease of debility; the blood is anæmic, there being very frequently a bellows-murmur with the first sound of the heart, and murmurs in the vessels of the neck.

541. The symptoms are, involuntary muscular movements; the muscles are not under the command of the will, but are cast about in the most extraordinary, absurd, and unexpected manner; the muscles of the face twitch, the head is jerked to one side, the hands and arms beat the breasts, and the legs twist. If a desired movement is made, it is done with great rapidity, as if the patient were doubtful of the continuance of the ability to carry out the motion, and glad when it is over.

542. The food is bolted with grimaces; and, altogether, the affection is one inspiring in the looker-on mingled feelings of astonishment, with sorrow for the sufferer. The cord and cerebellum are indicated as the centres principally affected by the disease, and the morbid excitement of these centres is produced by reflexion of irritation from some remote nerves, or is induced centrally by the anæmic condition of the blood. Some of the eccentric causes of irritation are—dentition, worms in the intestines, a collection of fæces in the colon, artificially induced irritation of the genital organs, arrest of menstruation, excess of

menstruation, conception, parturition, &c.; these will excite the peculiar condition of the cerebellum and cord to induce the muscular contractions, when those centres are prepared by the condition of the nutrition of the ganglion corpuscles, and by the anæmic blood, eo allow of such abnormal excitement; they, being removed from the power of the will, take upon themselves independent excitability.

543. There are, then, two indications for treatment,—the peculiar anæmic state of the blood, and the eccentric irritation. For the first there is a specific, namely, arsenic. Five minims of the liquor arsenicalis, two or three times a-day, with a little water, steadily persisted in, will cure almost any case of chorea; the eccentric cause of irritation being removed at the same time.

544. It is sometimes difficult to discover this latter cause; but with patience and a few experiments, we are sure at length to obtain a clue to it. At the same time with the arsenic, galvanism will be found of use in allaying the irritable condition of the cord. A continued current passed from the top to the bottom, or from the centres along the track of the nerves principally excited, is very efficacious; care must be taken to retain the direction of the current always the same, until the centres are quite soothed, as by altering it an increased excitement will be set up.

545. There are many other drugs recommended for the cure of chorea: sulphate of zinc, the carbonate of iron, hydrocyanic acid, nux vomica, &c.; but

arsenic is the drug above all others to be used as a specific,—iron to be combined with it if the blood be very anæmic, and the others used where indicated. It must not be forgotten, before commencing with arsenic, to remove the contents of the bowels with a purge of calomel and jalap: an emetic is frequently beneficial in the outset of the treatment.

546. As chorea is an anæmic affection, the diet must be generous. Good beer or wine is almost always necessary; meat well cooked, with bacon; or if more fatty constituents appear needful, a table-spoonful of cod-liver oil after meals, twice a-day, may be resorted to. Exercise (if the patient has the command of the lower extremities) in the open air is of course to be desired. I cannot say much concerning the cold bath, shower, douche, or sponging. Some recommend it, but I think in this affection it generally does more harm than good, increasing the nervous excitement. I am not accustomed to advise it myself.

EPILEPSY.

547. This disease may be named with truth "*one of the more obscure forms of nervous affections*," for its causes lie in deep obscurity. Epilepsy essentially consists of a partial paralysis of the functions of the brain, with increased and perverted action of the spinal centres. Without the two are combined, the disease is not true epilepsy.

548. The causes producing this combination are various. Firstly, there is an hereditary tendency to

convulsive affections. This I believe to be generally the case in confirmed epileptics. Thus, if in infancy the child be insufficiently or inappropriately fed, probably during dentition convulsions will result. If during childhood there be any cause of irritation, such as worms, second dentition, suppressed eruptions, excessive sexual irritation, or any other similar cause, an attack of epilepsy may supervene.

549. But besides the epileptic diathesis, handed down from the parents, the diathesis may be acquired by neglecting convulsive attacks in infancy and childhood, for the ganglion corpuscles of the centres soon acquire a habit, and the convulsive tendency, excited by some powerful eccentric irritant, may shortly be induced by a much milder form of irritation; and a habit being set up, a periodicity is induced, with or without eccentric irritation.

550. Then, again, there is a third form of the affection, where actual disease in the centres, their coverings or vessels, or of the neighbouring parts, such as the bony shell, may give rise to epileptic fits by centric irritation. I believe this to be rare, and when present has come on in more advanced age, and has not been habitual.

551. If an epileptic fit be watched from the commencement, which is seldom the case, it may be noticed that the patient becomes suddenly livid, a spasmodic and powerful expiration, through an almost closed glottis, produces a terrific scream, consciousness is lost, and the patient drops. Now commence a series of spasmodic clonic muscular contractions, quick and

rapidly repeated, principally affecting the upper portion of the trunk; the head is rhythmically drawn on one side, the eyeballs are turned upwards, the jaw grinds the teeth together, even to breaking; foam issues from the mouth, the breathing is difficult and spasmodic, and the arms are cast about. This may last from one minute to hours, the patient falling from one fit into another.

552. The very first symptom of an epileptic fit is the arrest of capillary circulation. This does not stop all through the system at the same time, but rapidly flies from spot to spot; it commences in the skin; a pallor pervades the surface, a *cold* sweat exudes from the pores. The minute arteries cease to supply blood to the capillaries; the consequence is—as I have explained from actual observation in the early portion of the work—the veins return their blood to the capillaries, and a ghastly expression is the result.

553. The arrest of capillary circulation in the brain and spinal cord, resulting from hæmorrhage, is paralysis of the functions of the brain; the cerebrum, the seat of the reasoning powers, &c., paralysed; the cerebellum, the seat of the combination of voluntary muscular action, &c., paralysed; the centres of the special senses, paralysed; and irregular spasm of the voluntary and semi-voluntary muscles under the control of the spinal centres.

554. This is followed by syncope, or cessation of the heart's action, when convulsions cease. But in epilepsy the heart does not cease to beat; on the con-

trary, the heart is excited to increased action; it struggles to continue the circulation, and that state is retained (when convulsions and loss of consciousness are coexistent) which occurs before syncope from loss of blood.

555. A struggle takes place between the heart on the one side to continue the circulation, and the microscopic arteries on the other to arrest it; the consequence being, that the capillary circulation is almost entirely carried on by venous blood. This is found to be the most favourable condition for convulsive action.

The state is induced by "*bouleversement*" of the sympathetic system; the nerve force is unequally distributed, some centres receiving too much and some too little, the result of a combination of circumstances affecting the normality of the sympathetic system, many of which are already mentioned.

556. To discover the cause of irritation is our principal aim, as also our chief difficulty; and in many a case the patient dies, with perhaps every remedy in the *Pharmacopœia* having been administered, and the cause never having been made out. Epilepsy is one of those diseases of which it is impossible to discover a specific, because the exciting causes are legion; but, except in a very few cases, where there is some organic persistent irritant, epilepsy is a curable affection.

557. In the first place, dentition in the young must be attended to, freeing the pressure on the gum by the lancet, or extracting a tooth which may be giving

cause to irritation. Attention to the state of the bowels, removing costiveness, arresting diarrhœa; attention to the secretions, expelling worms, careful and judicious diet, sufficient and not excessive exercise.

558. Trouble, an overburdened or overworked mind, fright, excess of sexual excitement, amenorrhœa, dysmenorrhœa, menorrhagia, any exhausting discharge or its sudden arrest, are all exciting causes of a fit of epilepsy; in fact, there is hardly any form of irritation of the nervous system which may not, in the predisposed, give rise to an epileptic fit; all such influences therefore must be carefully avoided.

559. In the young, where the cause is discovered and proper care taken, epilepsy is decidedly in most cases tractable. As the patient advances in years without being benefited by treatment, permanent injuries result—a peculiar jerking, dragging walk, a constant twitching of the neck, a fatuous look, and general imbecility supervenes, and any attempt at relief becomes at length hopeless. Still I am persuaded that the great majority of epileptics are curable, merely premising that the case is seen early.

560. The drugs which are most useful are—as purgatives, in slight constipation, the dilute aloes pill, given occasionally at dinner-time; for worms, kousso followed by castor-oil, turpentine, &c.; as tonics, salts of iron, zinc, and arsenic: where a syphilitic origin is suspected, the bichloride of mercury or iodide of potassium.

561. Where induced by excess of sexual excite-

ment, Dr. Locock recommends the bromide of potassium, as tending to allay it. If this preparation really prove a specific for this troublesome exciting cause of epilepsy, it will be invaluable. A new remedy for epilepsy is constantly appearing, and as constantly failing; what will do for one case is useless or prejudicial in another. I should say that the most generally useful drug is aloes; but the great aim is to discover the exciting cause, and with study and attention I think this may be *almost* always done.

562. The usual hygienic remedies must be carefully attended to, as they are our great aids in strengthening the system and preventing the attacks, by giving sufficient tone to the centres to aid them in resisting the abnormal reflexion of the exciting cause. The cold shower-bath is one of the most successful of these—of course used between the attacks, followed by friction of the surface when reaction is not spontaneously induced.

563. Spontaneous recovery from epilepsy has occasionally been noticed after the appearance of certain eruptions on the surface, or discharges—such as ulcers, small-pox, or more chronic forms of skin diseases, hæmorrhages, &c. From this it might be supposed that counter-irritation by blisters, setons, &c., would be beneficial; but as a rule it is not so; they generally, by lowering the patient, increase the number and violence of the fits. I have no doubt, that in a very small percentage, where there is a tendency to congestion from excess of nutrition, that they would be useful.

564. Caleb H. Parry, who practised more than sixty years ago, was accustomed to make use of pressure upon the carotids as a cure for epilepsy; not only successfully himself, but others have followed his example, and have met with like results. Thus, Romberg says, "I have repeated the experiment of compressing the carotids, and have found the proceeding to be an effectual prophylactic, if employed in patients who have forewarnings of their attacks, and are able to apply it in time." To perform the operation, the thumb should be pressed upon the artery upon a level with the superior border of the cricoid cartilage against the vertebræ. I have had no opportunity of verifying this assertion; but I have no doubt that if a patient has sufficient confidence to do it himself, that it would stave off a fit, merely by the effort of the will. It is the same with the deep inspirations recommended by Romberg to prevent convulsions.

565. A popular means of arresting the violence of the fit, namely, the casting of a large black silk handkerchief over the face of the epileptic, I have myself made use of, and it certainly had that effect in the instances in which I have used it, when present during the fit. In one case of hysterical epilepsy, where I had recommended this to be done immediately upon the appearance of the seizure, it calmed the patient down, and in a very short time she fell into a placid sleep, lasting for many hours. I do not pretend to explain its mode of action, but I record the fact; and it being so simple, there can be no objection to its use.

566. If an emetic can be administered immediately before or during the fit, and vomiting be induced, it will very much lessen its duration, or even arrest it; it is, however, almost impossible to give an emetic during the convulsions of epilepsy. It is the custom to cram the mouth with salt at some of our public institutions, to induce sickness; the constant expirations through the mouth, however, generally prevent its entering the stomach, and failure is the result.

567. Epilepsy is a terrible disease, destroying the beauty and utility of the body, and gradually sapping the brain until idiotcy supervenes. To prevent this termination is our aim; for when it has arrived, the body is in that condition, by bony growths, enlargements in the skull, &c., as to make it impossible to do any good; therefore, to arrest the tendency to epilepsy is our only chance; and this is to be effected in youth, and to this age must our remedies be directed. Each case requires separate study, and a separate method of treatment; it is therefore impossible in a short treatise to enter into the individual plan for each distinct case.

568. Many of these affections, if not actually originated, are frequently excited by the mode of life custom has entailed upon the youth of the present age. Custom, or Fashion—that remorseless tyrant, to disobey whose laws is to place oneself out of the bounds of society and sever many a bond of friendship—has directed that a young man on leaving school shall enter upon a life of dissipation, dissuaded from it neither by precept nor example, but expected from

him by his companions, and but faintly objected to by his parents. This system, which has been gradually creeping into our English homes, dividing brother from sister, mother from son, is the result of many causes, the chief of which is, the all-pervading idolatrous worship of gold, to procure which is the chief aim impressed upon the mind of the young man, and without which an early marriage is considered impossible. Oh! happy is that man who, spurning and looking down upon the narrow precincts of custom, frees himself from its trammels! At first he is shunned by his class, but in the end he is looked up to, respected, and even covertly envied; for the chains of custom, although worn, eat into the flesh of the wearer, and gall the most devoted worshipper.

569. An early marriage, by holding out a future for a young man, would enable him to curb his desires, the reward being a domestic life, respectable and respected. By this means would he escape many of the ailments of middle life, the seeds of which have been planted during the years of dissipation and carelessness.

ON DIET AND REGIMEN.

570. In the treatment of disease, especially in those affections of which I am writing, there is nothing more important than a well-chosen diet, and system of regimen. Although much can be done by judiciously chosen medicines, they will entirely fail, or merely be beneficial for a time, unless the food intro-

[illegible]

[illegible]

[illegible] to show the immense [illegible] which will take the place of that which should have been supplied with the food.

[illegible] This artificial, or rather extra work, which even in a healthy man, if carried through a long series of years (as may be seen in prisoners, &c.), leads to the generation of disease; in the weakly subject, or in one with an hereditary tendency to disease, gives rise to it immediately, or in a very short time,—first functional, then organic. This is but one example of the importance of a well-chosen diet, although many might be cited.

574. The four great proximate principles must never be lost sight of in the choice of a diet—the proteine, the starchy, the fatty, and the aqueous. The various modifications of these should be combined in a careful manner, so as to have proportions of each; and where one ingredient is found to disagree, another of the same character may be given to replace it, never, however, altering the relative proportions of the four great principles.

575. In a variable climate like that of England, much solid nourishment is required to create that amount of nervous force to resist the continued and sudden vicissitudes of the weather; otherwise, the daily use of so much nourishment is not required during the heats of summer, as in winter. Less meat, fat, and alcoholic drinks, which are so beneficial in cold weather, are required in the summer; and a diet consisting more of vegetables and fruit should be made use of.

576. The healthy stomach can digest anything,—nothing comes amiss; but in cases of indigestion, it is surprising what simple articles of food will cause pain and uneasiness. Every dyspeptic has his own peculiar trouble,—it is milk, or an acid, or tea, or veal, or one thing or other which disagrees; and very valuable intelligence does the knowledge of the aliment which disagrees give us; for upon applying it to its proximate principle, we find what article to give in its stead, and in a great measure are led to the correct form of treatment.

577. Thus, when we find that certain things taken into the stomach cause fermentation, and give rise to

flatulence, and when the urine is pale and passed in large quantities; we know that there is an atonic condition; that the hydro-carbons are required to arrest fermentation, as oil, alcohol, &c. (of course giving up the articles of food causing the derangement); and that some form of tonic will be beneficial; that the cold bath is generally required; and, in fact, an universal bracing form of treatment is indicated.

578. It would be impossible to lay down rules for every form of indigestion; but there are certain general principles which apply to all, and may be here advantageously introduced. In fevers and other acute maladies there is no desire for food. The sympathetic system, or portions of it, are partially paralysed; and it would be useless, or frequently detrimental, to administer food, as it merely gives rise to painful flatulence, increasing the miseries of the patient. Ice, ice-water, weak broths, acidulated drinks, weak barley-water, tea, brandy-and-water, wine-and-water, are some few of the articles of diet which may be allowed to a patient *desiring* them. I think that in very few cases any benefit is derived by forcing food upon a patient not desiring it.

579. I may take this opportunity of stating that what is called the "natural instinct" for a certain article of diet, is not always to be gratified. A patient who is convalescent from an acute disease, may, in most cases, be allowed to gratify his tastes, as in nine cases out of ten he will choose that which is good for him. But in those affections of which I am treating, the taste is generally depraved, food

which would be beneficial is loathed, and the most extraordinary and even disgusting articles are desired as food.

580. The method of cooking the different ingredients of a meal is of more importance than is usually supposed; the various changes produced by heat upon flesh, fats, vegetables, &c., make all the difference between that which will agree and that which will not. For instance, bread, which is essentially the staff of life, is to some an actual poison, not from the flour of which it is made, but from the change produced in its particles by yeast and heat.

581. In many forms of indigestion with flatulence, the most aggravated form of which is diabetes, bread is the article of diet which causes the greatest amount of anguish; and this not on account of the starch in the flour, which most authors blame; for if the very same flour be made into biscuits, no pain or flatulence will result; but on account of the yeast, which produces some change in the particles of the flour, causing a fermentation in the stomach, much nitrogen escaping; and the starch undergoes a further change into oxalic acid, or some other morbid ingredient; the same flour, differently cooked and prepared, being in one instance life and health, in the other pain, and even death.

582. For dyspeptics, as a rule, plain roasting, boiling, and broiling are the best methods of cooking. Frying is decidedly objectionable: the fats used are chemically changed, the fatty acids set free, and produce one of the worst forms of acidity.

Breakfast.

583. One of the most suitable articles of diet, agreeing with most dyspeptics, is properly cured fat pork, boiled. If this is nicely and sufficiently salted, it is relished hot and cold, and may be partaken of once or twice a-day with much benefit, where fats are desirable and other forms are not liked. It will form an excellent ingredient for breakfast, enabling the patient to start the day well.

584. Bread or biscuit, or a bread made from flour, but instead of yeast, sesquicarbonate of soda and hydrochloric acid used to raise it. The formula I copy from Dr. Pereira's Treatise on Food and Diet, page 320:—

"Flour, 1 lb.;
Sesquicarbonate of soda, 40 grains;
Cold water, half a pint, or as much as may be sufficient;
Hydrochloric acid, 50 ♏;
Powdered white sugar, a teaspoonful (*Better omitted*).

Intimately mix the soda and the sugar with the flour in a large basin by means of a wooden spoon; then gradually add the water with which the acid has been previously mixed, stirring constantly, so as to form an intimate mixture very speedily. Divide into two loaves, and put into a quick oven. immediately. If any soda should escape the action of the acid it causes a yellow spot, which, however, is more unsightly than detrimental. The sugar may be omitted if thought desirable." This bread may be made every day with great ease, by making use of one of Ball's

revolving ovens, which can be hung up before any open fire, and is very efficacious.

585. *Tea*, with milk and sugar, is nutritious, exhilarating, excites the activity of the brain, soothes the vascular system, diminishes the quantity of carbonic acid given off by the lungs and skin, and urea and phosphoric acid in the urine; it consequently diminishes the amount of waste of the system, and is a most valuable article of diet. It may be taken without sugar, or milk, or both, if found unsuitable. Tea by itself seldom disagrees, and can be strongly recommended.

586. *Coffee* exhilarates, allays hunger, and acts in much the same way as tea, and, with milk and sugar, is nutritious. I have found it occasionally give rise to flatulence when long kept, and having a caseous flavour.

Cocoa and chocolate—very nutritious, from containing a fatty ingredient—are found in many instances to be too rich; but, when they agree, are admirable articles of diet.

587. *Dinner*

Should, when possible, be taken in the middle of the day, as that is the time nature has pointed out as the most suitable for the chief meal. Custom and habit, together with hours of business, have arranged that an evening hour, more or less late, should be the time for the principal meal; there is much to be said in its favour; but for the dyspeptic, there is no doubt that one or two, according to the time of

rising, is the dinner hour. Active exercise should not be taken for at least half an hour before dinner, and an hour after the meal is concluded should be set aside for digestion, when a little gentle exercise is beneficial.

588. Where there is weak digestion, solid food, without much fluid, is found generally to agree best, the reason for which I have already endeavoured to point out. Roast beef; roast, boiled, or broiled mutton; boiled fish; venison, and most game, are found to be the best and most nutritious forms of food; although I have found mutton occasionally produce very singular symptoms. I am attending a young lady now, who, if she eats mutton in any form, although fond of it, always has a sleepless night, with headache and nausea.

589. All dyspeptics have their idiosyncrasies, which must be humoured, never forced. Light puddings may follow the meat; and cold brandy-and-water, sherry-and-water, claret, Allsopp's India ale, good porter, or water, may be taken in small quantities, according to the form of dyspepsia. The choice of beverage for each affection I have already adverted to. Some fruits, when in season, may be allowed after the meal.

590. *Tea*

Is a favourite and cheerful meal in many a home, and when found to agree, should not only be allowed, but encouraged. The family have generally finished the day's work, and the events that have occurred are

discussed; and good humour with comfort abound, both very conducive to health.

591. *Supper*,

With some, should be but a light meal, many being unable to sleep after a substantial supper. This I believe, however, to be a mere matter of habit, and a tolerably good supper will be found to be digested, in many cases, better even than a dinner. This arises from a person having finished the labours of the day (I speak of mental labour) before supper, when, throwing off the burden and relaxing the mind, the sympathetic system has more sway over the nervous fluid, not so much being required for the great centres; again, during sleep, digestion and assimilation are carried on with much greater activity than during the hours of labour, so that supper off one dish—say, chicken or boiled fish—will frequently be the meal of the day which is best digested, and does the patient most good.

Articles of Food very frequently found to Disagree.

592. *Milk*, although one of the most nutritious and valuable articles of diet, is found by some to be indigestible. This may arise from the curd, from the butter, or from the lactine: it is important to discover which, as the objectionable ingredient may be removed.

593. *If the curd*, a portion of milk should be set aside that the cream may accumulate, after removing

which, about half a tea-spoonful of prepared rennet to the pint of blue milk should be added, and then placed upon the fire; the caseine will coagulate, and the whey, added to the cream, may be taken with impunity.

594. *If the butter*, skimmed-milk should be made use of.

If the lactine, to fresh-drawn milk the rennet should be added, and, after heating, the curd will separate; strain off the whey, which contains the lactine, and the curd, consisting of caseine and butter, can be eaten.

595. *Bread.*—I have pointed out one instance where bread disagrees, but there are others, when much alum is used by the baker to make the bread white, or when gypsum is introduced by the miller as an adulteration; or when the yeast—generally the German—is bad, as it frequently is; or when the bread absorbs deleterious gases whilst cooling, as it may do, instead of pure air.

596. *Fats.*—Fats, when they are found to disagree, do so, not from want of digestion, but on account of it. In healthy digestion, fat is merely very finely divided in the stomach, absorbing nitrogen, and probably coated with some form of proteine; but where it does not agree, it is separated into its constituents, the fatty acids are set free, which by their acridity give rise to much uneasiness, and in many instances cause vomiting.

597. This separation of the fatty acids is greatly assisted by the fats boiling during cooking as in

frying, when also an acid volatile principle is given off. Most forms of fat and oil disagree with dyspeptics; and as fat is one of the four principles without which health cannot be retained, it must be taken in some form; I have already stated that the pickled fats are found to agree best—such as boiled pickled pork.

598. Cod-liver oil is an admirable form of administering fat, as from the ingredients derived from the liver contained in it, it is more easily absorbed.

599. *Fish.*—Salmon, eels, and herrings contain much fat, and for this reason are frequently found objectionable. Shell-fish, except the raw oyster, are indigestible. The best fish for dyspeptics are,—the whiting, sole, haddock, plaice, and flounder, plain boiled. The turbot is also very nice, but the tough skin should be avoided.

600. *Fruits and Vegetables.*—Almost all raw fruits and vegetables are, more or less, indigestible. Vegetables should be well and thoroughly cooked. Perfectly ripe grapes and oranges are often desirable, and in general can be recommended. All stone-fruits are bad, particularly when unripe. As vegetable food is necessary to a complete dietary, much care should be taken to ascertain those which are unobjectionable in each particular case; this is only to be discovered by experiment, and rules cannot be laid down. The potato is one of the best, and least likely to disagree of any: they should be thoroughly boiled or mashed.

601. *Condiments.*—Spices, peppers, &c., stimulate

the stomach to increased action, and in some few cases can be recommended, but only where a temporary benefit from their use is desired, as during convalescence, &c. In the confirmed dyspeptic, although they apparently do good, they in reality but increase the difficulty, and in the end make the patient worse, as every day an increased quantity is required to excite the languid organ to digest the food introduced into it.

602. This may be said of almost any stimulant, which may be useful to serve some temporary purpose, to assist digestion during a temporary paralysis of this function; but in the gradual loss of power, which is the case in diseases of long standing, it will, although apparently beneficial for a time, eventually but remove what little secretory power the stomach retained.

603. Where the functions of the stomach are partially paralysed from any cause, and we wish to rest that organ, food should be administered not requiring *digestion* by the stomach. Solid food should be avoided, fluid only being given, and that of a character that will not coagulate. At the head of these is milk and lime-water, the lime-water preventing the coagulation of the milk, which on passing into the intestines is there rapidly converted into chyle; whey, a very useful article of diet, containing the lactine and salts of the milk; broths, which are rapidly absorbed, requiring little or no digestion; Liebig's cold extract of meat with lime-water, a

valuable preparation, containing the albumen and extractive matters.

604. Where there is plenty of saliva, starchy decoctions are beneficial, as the stomach is not called upon to digest this principle, although probably the conversion of that ingredient into sugar, fat, proteine, &c., does take place to a slight degree in the stomach; if therefore the starches do not undergo a healthy change in the stomach, but are converted into oxalic acid or low sugars, then they must be discontinued. It is seldom that this is the case, the starches being almost the last ingredient of our food which is not digested and assimilated.

605. Where the small intestines are paralysed for a time, and the stomach is healthy, all fats must be strictly avoided, as also the starches, for they may be converted into a fatty element. The food should be adapted for absorption by the capillaries, as broths, alcoholic drinks well diluted, jellies, &c.

Where the stomach and small intestines are incapable of receiving food, nourishing clysters may be thrown up into the large intestines; and broths, fats, and wine may be rubbed into the skin.

606. In certain diseases it is necessary to remove old diseased tissue, and form fresh, as in secondary syphilis,—in some chronic skin affections, where much metallic medicines have been taken,—in some forms of struma, gout, rheumatism, &c. To effect this, we must inquire of what we have learnt from physiology, pathology, materia medica, and chemistry, before a

complete system can be laid down; but as in these obscure affections we are frequently desirous to do this, I shall describe a plan I am accustomed to make use of myself, and have found advantageous.

607. Firstly, to remove diseased tissue. This can be effected by the bowels, kidneys, skin, and lungs; and all these must be set to work; they all remove water, but not alone; with it passes off the *débris* of destructive assimilation. Primarily, then, much water must be absorbed to mix with the blood, to afford the medium for removing the obnoxious materials; and this should be taken on an empty stomach, so as not to interfere with the new materials with which we wish to renew the body.

608. The first thing on rising from bed, half a pint of pure water (distilled is the best) should be taken, and followed by a rapid walk; perspiration will be induced, and the lungs will remove much, as vapour; upon returning from the walk, in the commencement of the treatment, a tepid bath, later a cold sponging bath, should be taken; this will free the skin from the impurities thrown out, and also will give tone to the system.

609. Breakfast should consist of a basin of oatmeal porridge, with milk, bacon, eggs, and bread,—as much as may be desired. Tea, coffee, cocoa, quinine, and opium, preventing the destruction of tissue, should be avoided; and beer, wine, and spirits, which save the system the trouble of creating its own nerve force, must, after the first week or two, be done away with. It is hardly possible at the early commence-

ment of treatment to remove all stimulants; the least objectionable, good beer, or wine-and-water, may be persisted in until they can gradually be discontinued.

610. The oatmeal porridge, especially with Londoners accustomed to white bread, acts as a gentle stimulant to the bowels, and is at the same time very nourishing. Shortly after breakfast, business may be transacted for an hour or two; and four hours after breakfast, when the stomach is or should be quite empty, another half-pint of water, or even a pint if the patient can bear it, may be taken,—followed by a good brisk walk, the lungs and skin removing much effete matter.

611. The walk concluded, and after half an hour's rest, dinner may be taken, which should consist of fish, if obtainable; good meat, roast or boiled; well-cooked vegetables; bread; and during the fruit season, a little ripe fruit;—as little to drink as possible; at least four hours' rest after dinner, that is to say, no active bodily exercise; then a pint of water and another brisk walk, followed by supper about 7 P.M., the same description of meal as breakfast, retiring to bed about ten; before which a tepid bath should be taken, and half a pint of water drank. The medicines must depend upon the case.

612. By this regimen, all the emunctories of the body are actively employed, much destruction of tissue takes place, and much new matter is laid up for future use: it depends upon the patient following out the rules, whether this new material is good. If the patient is so situated that he can be under the

eye of his medical adviser, then the use of electricity will very much hasten the cure; as by making use of the electric bath the excretions from the skin are much augmented, the skin being excited to greatly increased action; and by the use of the stimulus of electricity to the ganglionic system generally, the work upon which we are engaged is simplified and hastened.

613. I must here say a few words on costiveness. In almost all cases of nervous debility costiveness is a troublesome symptom, and one from which the patient prays to be relieved, as he knows the bad effect it has upon his malady. It is very easy to prescribe aperient medicine, and it always has a beneficial action at the time; but shortly the same dose, if persisted in, will have little or no effect, except to lower the powers of the patient.

614. Costiveness depends on an infinity of causes, amongst the chief are a deficiency of, or abnormally secreted, bile; a deficiency of the acid secretions of the intestinal canal; flatulence; a want of tone of the muscular coats of the intestine, and deficient nervous influence. The remedy must be directed towards the failing organ or system, and it must be of two kinds, general and local.

615. The general treatment of costiveness is that adapted to the improvement of the health—namely, tonics, the cold bath, dry rubbing, friction, exercise, a suitable diet, amusement, absence from business, &c.; the local must be addressed to the organ in fault. If there is a deficiency of bile, shown by the paleness

of the fæces, a gentle stimulant to the liver, nitro-muriatic acid internally, and taken as a bath every morning; or the region of the liver to be rubbed with the acids night and morning, will usually succeed.

616. If the bile is unhealthy, as may be detected by the colour of the fæces—green or blackish—the acids, or a gentle mercurial, may be given as an alterative. If from deficiency of the acid secretions of the canal, quinine is indicated, being careful not to arrest the secretion of bile, which quinine will do if not watched and prevented; rhubarb is also of great advantage where there is a deficient acid secretion; quassia, gentian, and calumba improve the secretions of the mucous membrane, without closing the liver, and are therefore to be preferred.

617. Flatulence, frequently a very tiresome complication, especially in hysteria, may be relieved by the essential oils and gum resins, combined with rhubarb and aloes, given in pills at dinner; peppermint for the stomach; myrrh, galbanum, asafœtida, &c., for the intestines. In an atonic condition of the muscular coats, and want of nervous energy, strychnia is all-powerful, and is the best remedy that can be used; combined with rhubarb or aloes, or both, it will seldom or never fail; it should be given in pill every day at dinner, continued for a fortnight or more, the dose being from the twentieth to the twelfth of a grain. All who have tried strychnia in atonic costiveness must have been pleased with its mode of action.

MEDICINAL PREPARATIONS.—THEIR APPLICATION DERIVED FROM THE STUDY OF THE INTRODUCTORY REMARKS ON THE PHYSIOLOGY OF DIGESTION AND ASSIMILATION.

Medicines to be taken before a Meal, to stimulate the Nerves to the Secretion of Gastric Juice.

618. Cayenne pepper, ginger, and spices generally; camomile, hop, gentian, and the vegetable bitters generally; quinine in small doses; chalk; rhubarb, and alcohol. The only preparation requiring notice amongst these is chalk—carbonate of lime; it is an alkaline carbonate, and as such stimulates the polar condition of the nerves of the glandular mucous membrane to the secretion of the acid pepsine, not as the cayenne pepper, &c., by increasing the flow of blood in the parts, but by a chemical stimulus to the nerves themselves an increased flow of acid is induced; and the advantage of chalk over the alkaline carbonates is, that it does not increase the amount of alkali in the blood, as soda or potash would do, but, combining with phosphoric acid, is the great stimulus to the formation of the chyle-cell, and consequently the blood-corpuscle: magnesia is of the same character, and is only second to chalk.

619. *Pepsine*—liquor pepticus, prep.—is to supply the place of the natural secretion, when, by paralysis of the sympathetic of the mucous membrane of the stomach, there is not sufficient poured out for the wants of digestion. It is very useful after fevers, and

in those cases where the system is paralysed for a time, enabling, by the production of fresh blood, the stomach itself to weather the crisis, and consequently to secrete its own pepsine; it should be carefully given, and gradually lessened from the first dose, if possible, as, should the stomach get into the habit of having its work done for it artificially, more harm than good will be effected by its administration.

Medicines to be taken after a Meal, to assist Digestion and Assimilation.

620. *Hydrochloric acid*, diluted, about half an hour after a meal, assists digestion, as that is the natural acid of the stomach, together with the lactic, which is, however, generally derived from the food. The acid is required only where the food is of an animal or proteine character, as the starches do not require an acid for their digestion.

621. *Phosphate of lime*, in solution, by the aid of dilute phosphoric acid, is one of the most valuable of tonics; and although perhaps not aiding much in the digestion of a meal, yet, as the stimulus to the formation of the chyle nucleus and cell, and secondarily of the blood-corpuscle, is of the greatest value in assimilation.

There is no preparation that I have ever used, that I have more reason to be satisfied with than this. It is a powerful blood stimulant, and consequently tonic. I was led to its use after my observations upon the formation of the chyle-cell. I can conscientiously

recommend it to the profession in chlorosis and anæmia generally; combined with iron, it is invaluable. The indications for its use are, an insufficiency of red blood, an atonic condition of the nervous system, and in anæmia generally: an excess of acid should be used when there is a deficiency in the gastric secretion.

622. *Iron.*—The use of iron is, I believe, generally well understood.

Cod-liver oil.—This medicine takes the place of what should always be a constituent of every meal—fat. But many people have so great a loathing for fat, that it is impossible for them to eat it. Cod-liver oil is given instead, it being more digestible than the fats of meat unprepared by salting, smoking, &c. As fat (oil) is one of the chief ingredients of the chyle, and without it the blood would cease to be formed, it is quite evident that it is a most necessary ingredient of the food.

623. In health, the stomach has such wondrous powers of conversion, that, whatever food is taken, oil is produced; starch, sugar, proteine undergo changes, and fat appears: but when the system is lowered, and the nerves are partially paralysed, this power is lost; and if no fat is taken, no oil is produced, the chyle is poor, little fibrine is formed, and few blood-corpuscles; then cod-liver oil should be given, as it is fat in such a condition as most readily to be converted to the uses of chylification, requiring no aid from the weakened stomach.

624. I believe there are many fats which will do

equally well, as good bacon, almost any fat preserved by salting, smoking, &c.—chiefly pigs, as that seems most easy of digestion. I am accustomed to gradually leave off the cod-liver oil, increasing the amount of fat taken with the food, as eggs, cream, bacon, boiled fat pork, butter, &c.

625. *Bicarbonate of potassa, sesquicarbonate of soda.*—Where an excess of acid is formed in the stomach, either through improper food or a certain diathesis, allowing the conversion of saccharine ingredients into lactic acid, or fatty into butyric acid, these alkaline carbonates are useful, to afford bases for the free acids in the stomach which irritate the mucous membrane, and are even occasionally absorbed by the capillaries, turning the blood black. The carbonic acid is evolved as gas, stimulating the muscular coats of the stomach to pass on the food, and freeing itself through the œsophagus. The acids combining with the bases are absorbed, and in the liver undergo further changes, and are excreted chiefly by the skin and kidneys. The alkaline carbonates assist digestion by neutralizing these irritating acids, and should be taken when inconvenience is felt, generally from one to two hours after a meal.

626. *The trisnitrate of bismuth* is a useful drug, and acts as a soothing application to the irritable mucous membrane; it arrests secretion of morbid mucus, and is usually given from three to four hours after a meal, to allay irritation, and to stop a tendency to vomit, which accompanies the secretion of the watery mucus, which is thrown out by the mucous membrane in

large quantities after the meal is passed into the duodenum, and when the stomach should be quiet. It appears to act upon the nerves as a sedative; I believe topically, for I do not think it is absorbed into the circulation, as the greater part, if not the whole, is passed at stool as a black precipitate, probably the sulphide of bismuth.

Medicines to stimulate the Liver to increased Secretion of Bile.

627. *Mercury* must certainly be placed at the head of these, because it is the most powerful, and seldom fails.

Calomel should be given in one dose sufficiently powerful to act upon the liver at once, as a second should be avoided if possible; one, two, three, or even four grains may be given at bed time, with ipecacuanha and colocynth or jalap, and the effects removed the next morning by a purgative draught; this is generally sufficient, preparing the way for any further treatment desired; and in the general routine of practice a second dose should not be administered, as any mercurial carried sufficiently far to affect the system is as a rule bad, and damages the powers of life, by arresting for a time the acidifying powers of the nervous system, exalting the alkaline poles. Of course there are exceptions; but in nervous affections, indigestion, &c., mercury, beyond the one starting dose, is a poison.

628. *Blue-pill* is less powerful than calomel, and is useful as an alterative,—two to five grains for a dose.

Hydrarg. cum cretâ—grey powder—is also a useful alterative, especially with children; the chalk corrects the acidity of the bowels, and the mercury acts upon the liver, and alkaline glands generally, increasing the powers of the alkaline poles of the nervous battery and decreasing the acid. Mercury acts upon the liver, it being the principal alkaline pole of the nervous system; but it also acts equally upon all the other alkaline glands, increasing their secretion. Mercury acts beneficially for a few doses, but carried farther, the benefit is arrested; and injury to the nervous system results.

629. *Nitro-muriatic acid* acts also upon the liver; not, however, so certainly or so rapidly as the mercurials. It has to be taken some time before the effect is perceived; it also has to be continued, otherwise the effect would wear off. It appears to me to act upon the nervous system, by supplying the acid secretion to the stomach, thereby removing some of the labour from the acid poles, so that more of the nerve force accumulates at the alkaline poles, stimulating them to increased action to neutralize the acid in the stomach. It has this superiority over the mercurial preparations, that it is not depressing,—rather the contrary. It should be given from one to two hours after a meal.

630. *Taraxacum* is but of slight use. It may afford a menstruum for the administration of the nitro-muriatic acid; but in case it should excite diarrhœa, which it frequently does, it must be omitted: the decoction is the best form of preparation.

The nitro-muriate of ammonia, prepared by adding the carbonate of ammonia to saturation to the dilute nitro-muriatic acid, is an alterative—acts upon the liver, and is cooling to the system; it is not, however, tonic, but slightly depressing—very much less so than mercury—and has not the after mal-effects of that mineral; it stimulates the secretions powerfully, and is very useful in mild fevers, allowing a rapid recovery; it should be given in doses of from xx. minims to ʒj., every three hours, in a little water, and should be continued until the skin is moist, the kidneys act, and the bowels have been relieved, when it should be discontinued.

ON THE ACTION OF QUININE.

631. This most powerful of all medicines acting upon the ganglionic system of nerves, is but little understood; and, although it has been in use so many years, its true mode of action has not yet been made out; empirically, it is given in large single doses, to prevent periodicity in fevers, and in small repeated doses it is given as a tonic. Its use is becoming more general in the treatment of fevers; but its therapeutics are little understood.

632. It appears to me to act chiefly upon the minute arteries, through the nerves of the ganglionic system, supervising their muscular contraction, thereby balancing the supply of blood to all the tissues, glands, and systems. In the twenty-four hours the blood accumulates in the glands, organs, &c., at

certain times, and for certain periods; according, in the first place, to laws laid down by nature, and secondarily, to habit.

633. These local congestions, or determinations of blood, depend upon many causes,—to the ingestion of food, to secretion, to excretion, to the nutrition of the part, to mental emotions, to exercise, &c.; but during health these congestions last but a time; the blood by degrees is removed, by the contraction of the small arteries stopping to a certain extent the supply, by the tonicity of the tissue itself not requiring the arrest of blood for secretion, nutrition, or whatever the cause may be.

634. For, tissue, which is formed from the melted-down blood-corpuscles, is always *en rapport* with the blood and nerves, and has the power of attracting the blood to it, or of hastening its circulation, according to its own requirements; so that local congestions are a consequence of health; they are but temporary, and last a certain time, and after their removal the part is less supplied with blood.

635. The congestion depends upon two causes,—the increase in the calibre of the small arteries, allowing a larger supply of blood to pass, and the attraction of the part itself for the blood. The congestion is removed by the part no longer attracting the blood—in fact, repelling it—and the contraction of the minute artery not allowing so large a supply of blood. Now it can be easily understood, that by lowering the vital powers (from whatever cause) this tonicity, both of the part and of the muscular coat of the

artery, may be impaired, as in ague, or may be entirely lost, as in inflammation.

636. The action of quinine corrects this want of tonicity, imparting to the part, and to the muscular coat of the artery, that which it wants; it is therefore a stimulant to the peripheric terminations of the ganglionic system of nerves, as well as to the minute ganglia themselves, not by imparting an increased supply of nerve force, as an alcoholic stimulant would, but by producing certain molecular changes in the ganglia, thereby increasing their power of induction.

637. Quinine, therefore, would be only of secondary utility in diseases where the blood is primarily affected, the nervous system suffering in consequence. This is proved in certain forms of anæmia and chlorosis, where iron is of benefit; for until the iron is given, quinine is not of the slightest use. Again: in low fevers, until after the use of stimulants, to supply the nerve force, the inductive power of quinine is of no use. Again: in inflammatory fevers, where there is rather an increase of nerve force, quinine is of no benefit—in fact, detrimental. In hysteria, where quinine might be expected to be beneficial, it is seldom, in the early stages of treatment, of any benefit. When the attacks are over, to increase the powers of the system, it is useful.

On the Action of Opium upon the System.

638. Opium acts primarily on the nervous system; it increases the inductive power of the ganglia, not only of the sympathetic, but of the spinal cord, and the brain. The person taking it feels invigorated; the faculties seem clearer, and he is capable of increased mental and bodily exertion, requiring less food to produce these effects. The dose not being continued, a state of prostration follows.

639. Whilst taking opium, the excretions are decreased, there is not so much waste going on in the capillary system—that is to say, the inductive power of the ganglia is so increased that the usual amount of nerve force is not required to produce the same effects; therefore the molecular change in the capillaries is lessened. To avoid the prostration following its administration, the dose must be continued, and increased.

640. In larger doses, opium, after the stimulant effect, produces sleep, which appears to be the method of repair of the ganglionic centres, after the molecular change excited in them by the drug. Opium is most useful in chronic diseases of depression: given in small regularly-repeated doses, continued for a considerable period, it allows time for other treatment, lending a fictitious strength to the nervous system. In almost all the affections I have mentioned, it is beneficial; in small doses, increasing the tone of the nerves; in large, allaying irritability and producing sleep.

On the Action of Arsenic upon the System.

641. Arsenic appears to me to act both upon the nerves and blood. It becomes a part of the blood, as it is deposited in most of the tissues, when taken in any quantity. There are some chymists who assert that it is a normal constituent of the body. The excess taken passes off in the urine. But arsenic acts powerfully upon the nervous system, in very much the same manner as quinine; for it will cure an ague even when quinine fails.

642. Ague we know to be the result of a malarious poison, entering the blood with the air we breathe; it has the power of paralysing for a time the inductive power of the minute ganglia of the sympathetic system in a specific manner. Quinine probably has the exactly opposite effect, increasing the inductive power; therefore, where quinine is beneficial, it enables the ganglia to resist the effect of the poison. Arsenic appears to me to act by destroying the poison; meeting with it in the blood, it is an antidote to it. But then arsenic cures chorea. True; but so does iron and zinc. These metals afford a something to the blood which enables them properly to nourish the nervous system, which before was improperly nourished, and had lost its equilibrium. This is regained by the use of these substances.

643. Arsenic acts principally upon the lining and covering tract, the skin, and mucous membrane. In medicinal doses, it acts chiefly upon the skin, improving its secretion, and remedying any disease

there may be present. It also acts upon the mucous passages, increasing their tone, and arresting morbid secretions, replacing them with the natural. In increased doses, the action is changed; heat and dryness is experienced in the skin, throat, and alimentary canal; diarrhœa is induced with much pain; and a general langour pervades the body.

644. Arsenic should not be persisted in beyond a certain time. As long as it is doing good it may be continued; but when the benefit has ceased, then it should be discontinued; or if it does no good after a few days, it should not be persisted in; or when the specific congestion of the conjunctivæ has commenced, or dryness and heat in the œsophagus, it must be stopped at once.

645. It is not a drug like quinine, that almost any dose may be given without danger, or may be persisted in for any time. Arsenic is a useful drug in careful hands, but dangerous where not watched. It should never form the ingredient of a prescription.

646. And I must say a word or two here upon prescriptions. A patient sees a physician, obtains a prescription, with proper directions given at the time. It does him a great deal of good, and he leaves London. That prescription is set aside with, perhaps, many others, carefully docketed "Very valuable—just the thing for me." If a friend is ill, or he himself should again be ill, he does not send for a medical man: no! he has got a prescription from a London physician, for which he paid a guinea, or perhaps many guineas, which of course enhances its

value in his eyes; he will take that, as it agrees with him so well, or he will lend it to a friend.

647. To his astonishment, it not only has not the effect it had before, but he becomes daily worse, and has at last, when he is half poisoned, to send for his medical neighbour. This is no exaggeration. I have met with many who have twenty, thirty, or more pet prescriptions, which they take occasionally, when they are ill, haphazard, or to the best of their knowledge. Now, where a prescription contains arsenic, mercury, &c., the injury that may be done, perfectly innocently, by all parties, must be apparent.

On the Mode of Action of Strychnia.

648. This most powerful drug acts by increasing the inductive power of the cord and cerebellum, and gives the power of originating muscular contraction to those centres. It also increases the reflex function of the cord to a great degree. It affects the ganglionic system in the same manner that it does the cord, except that each ganglia is an independent centre, supervising the reflex action of the part over which it exerts its influence, so that in small doses it may act locally, upon the stomach alone, without affecting the whole system, as is the case where the cord is influenced by it.

649. In minute doses, it is very advantageous in an atonic condition of the stomach, lending tone, and, with other drugs, stimulating the secretion of the gastric juices. I say with other drugs, because I believe strychnia merely stimulates the centres of

motion,—those that excite the contraction of muscular fibre. There are few drugs more beneficial in anæmia than strychnia; but it requires careful watching, and should be administered in minute doses, two or three times a-day. The dose must be increased when we wish to act upon the cord.

650. In combination with rhubarb, it is a good stomachic. I usually give it about a quarter of an hour before food. In hysteria, strychnia is very beneficial, and is the only *decided* tonic that can be relied upon in that affection. It may be given at any time, and is most useful in the atonic forms of that complaint. It appears to act by re-establishing the equilibrium of the nervous centres, and restraining the nerve force within their proper ganglia, not allowing the sudden rush and accumulation of nerve force upon one centre, or system of centres, which is the peculiarity of hysteria.

THE THERAPEUTICS OF GALVANISM AND ELECTRO-MAGNETISM.

651. In all the diseases of which I have treated, the tone of the nervous system being lowered, or its equilibrium upset, the stimulus of electricity is valuable. I am accustomed to make use of it, in many cases, as an aid to other treatment. I do not think, alone, that it would cure any disease; but as an aid I have much confidence in it. It is a powerful stimulus to the jaded nerves, increasing their irritability and lending tension to the centres.

652. Electricity prevents the coagulation of the

blood, as has been proved by Schubeler and others. It is a powerful exciter of the secretions, by increasing the flow of blood through the part, as may be seen in the frog's foot under the microscope, and may be practically proved by applying the poles to the cheeks, in the neighbourhood of the salivary glands, when an increased flow of saliva is set up.

653. Innumerable experiments by Galvani, Matteucci, and numberless other observers, prove that the nerves and centres are stimulated by the passage of electricity through them; the only difficulty at the present time being the mode of administering the stimulus, and of confining it to certain tissues or organs, and this has not, I believe, yet been solved.

654. Electricity as generated by chemical decomposition is that of which I speak, as large quantities can be procured with ease, large quantities being required. Thirty pairs of plates are sufficient for any medical purpose, and they need not be very large—three inches square being sufficient. Smee's battery is a convenient form: this should be attached to an interrupter, when the electricity generated does not pass in a continuous current through the body, but in small, interrupted, intensified currents.

655. The most convenient and portable is the electro-magnetic apparatus, in which the electricity generated is intensified by induction through a long coil of wire, and applied in this form. The two methods are required for different purposes. I consider the induced and intensified current is most suitable for stimulating old paralysed muscles and

the nervous system of the cord; the interrupted electrical current, for stimulating the sympathetic system of nerves, as the violent shocks of the induced current would be too severe for these nerves.

656. To prove that an interrupted current is most suitable for stimulating the nerves of motion—those supplying muscles—the experiments of MM. Longet and Matteucci may be adduced,—that "During the time the circuit is closed the muscles are quiescent, but that at the commencement and cessation of the flow of electricity contractions are excited."

657. Through the ganglionic nerves the current passes more slowly, as each centre acts as an interrupter. A continued current, or merely a simple interrupted current, may be applied to this system. Matteucci, in his experiments, finds that muscular contractions (in muscles controlled by the sympathetic) do not commence immediately upon the closure of the circuit, but some time after, and continue after the current has ceased.

658. In the administration of galvanic electricity for medical purposes, it must not be forgotten that the skin is an exceedingly bad conductor, and that a certain amount of intensity is required to cause the current to penetrate it, otherwise it will merely wander over the surface, the fluid being conducted to the other pole by the aid of the perspiration always induced by galvanism; therefore the intensity should be in all cases sufficient to cause a pricking sensation at the positive pole: this is assisted by moistening the surface upon which the poles are placed with some saline or acid solution.

659. The interrupted current should be only used during short periods, as it exhausts the irritability of the nerves, although stimulating them at the time. The quantity to be administered, and for how long, can only be acquired by practice: from ten minutes to commence with, to an hour, and then again gradually lessening the time, is the most useful plan.

660. In cases where a continued supply of the galvanic stimulus is required, the method of proceeding is,—after the muscles have ceased to respond to the stimulus, alter the situations of the poles of the battery; place the positive pole where the negative was before, and *vice versâ*, the muscles will immediately respond to the fresh stimulus. This is founded upon the rule laid down by Matteucci,—"The electric current restores the excitability of a nerve which has been exhausted by a reverse current."

661. The method of administering galvanism, or electro-magnetism, to the jaded nervous system is as follows. I am accustomed to commence with a Pulvermacher's chain of the highest power, from its ready portability enabling it to be carried to the patient, if required, without trouble. This is excited with a little vinegar; and with directing wires the negative pole is applied to the cervical vertebræ, a small piece of moistened flannel being placed between the metallic disk and the skin.

662. The positive pole is placed to the pit of the stomach, a larger piece of moistened flannel being used, and a piece of metal, the size of the palm of the hand without the fingers, acting as the pole. Upon

the first administration this may be kept applied from five to ten minutes, and then, the poles changed—the positive to the neck, the negative to the pit of the stomach, for the same time. At each visit the time should be prolonged by five or ten minutes. When relief has been gained, the electro-magnetic apparatus may be made use of, and more powerful currents transmitted, feeling the way cautiously. When the amount of benefit expected has been derived, then galvanism should be discontinued as gradually as it was commenced.

663. I may, without exaggeration state, that there is more benefit to be derived from galvanism than any *single* remedy I am aware of, and that, as an aid to other remedies, it is invaluable. Dr. Wilson Philip, Dr. Golding Bird, Dr. Pereira, and numerous renowned foreign physicians, have made use of galvanism as an aid to medicine; and why it has fallen into disuse, or merely used ex-professionally, I am at a loss to discover. I expect much from it, especially if a better method of administering it to particular internal organs can be discovered, and I do not despair of this.

664. With a good apparatus, it is very manageable, and easy of administration; a current, so delicate as not to be perceived by the nerves of sensation, or one that could kill an animal by one shock, can be generated by the same battery, merely requiring regulation, and that of the simplest description.

665. If we wish to stimulate the nerves of sensation, an interrupted current, applied with the aid of

a metallic conductor to the dried part, is the mode of proceeding; if the nerves of motion, an interrupted current, applied with a metallic conductor to the moistened skin; if to the deeper organs, or the ganglionic system of nerves, an interrupted current, applied over a large moistened surface by the aid of water, an acid, or a saline solution.

666. The continued current, in a uniform direction, is used in acute neuralgia, where the nerves are over-excited, and care must be taken that the positive pole be applied to the painful spot, and the negative as near the nearest centre as possible; and no change must take place in the direction, otherwise the pain will be renewed.

667. The cure is effected by deadening the sensibility of the nerve, which from some cause or other, has been over-excited; and it appears to me that this so-called hyperæsthesia of the nerve, or over-excitability or sensitiveness, arises from paralysis of the ganglia, or centre supervising that nerve; and that the nerve force, instead of being received by the ganglia and conducted away, is retained within the nerve and its peripheric terminations, and pain is the result. But the increased supply of electricity forces its way through the ganglia, and relieves the pain. Of course this does not apply to pain arising from inflammation or injury to a part, or reflected pain, but to what has been termed neuralgia.

668. It must not be forgotten that the current enters the body at the positive or zinc pole, and is removed at the negative or copper, so that a current

may be directed from the centre to the circumference, or *vice versâ*. In stimulating nerves of sensation, the positive pole must be placed at the periphery, the negative at the centre, and the current must be interrupted. In soothing nerves of sensation, the direction must be the same, but the current must be continuous. In stimulating nerves of motion, the positive pole must be placed at the centre, the negative at the circumference, and the current must be interrupted: in soothing, the current must be in the same direction, but continuous.

669. We have more difficulty in dealing with the ganglionic system; and I am now engaged upon experiments directed to the elucidation of this subject. The rules are the same as those laid down above, there being required more nicety in the application to penetrate to the ganglionic centres. Moist and acid conductors must be used, and it is very possible that the electric bath will be found the most efficacious mode of administration, when we wish to stimulate or soothe the whole system; but when one organ is to be soothed or stimulated, there is undoubtedly much study and many experiments to be entered into before any certainty of therapeutic influence can be obtained. I have, however, seen quite enough benefit derived from galvanism (chemical electricity) to encourage me to perseverance in the study of this powerful and beneficial agent.

670. According to the theory I have hazarded, of the production of nerve force generated in the capillaries, and made use of by the cord and brain, the

mode of stimulating this process would be, by interrupted currents being applied to the whole surface of the body, and passing off by the spinal cord at the back of the neck. To effect this, a wooden bath should be used, with a strip of metal running all round it, or along the bottom, so as not to touch the body; to this the positive pole of a rather powerful battery must be attached; electricity will enter the body at every pore, with the acidulated or saline solution, and may be removed by the negative pole at the neck, twenty or thirty times a minute, by an interrupter, either in the hands of an attendant, or the patient.

671. This is one method of stimulating the ganglionic system, and may be effected without much trouble in the patient's own bed-room; but it may be done in a less perfect manner in a foot-bath, or by the aid of cloths damped with acidulated water and placed over certain parts, a large metallic conductor being used.

672. To mention all the various methods by which galvanic electricity may be applied, would require more space than I can afford; the outline being given, each observer can experiment for himself so as to obtain a ready method of administering the fluid.

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